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NATIONAL DEFENSE ISSUE

AUTOMOTIVE INDUSTRIES

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PRECISION IN MASS PRODUCTION

OCTOBER 1, 1940

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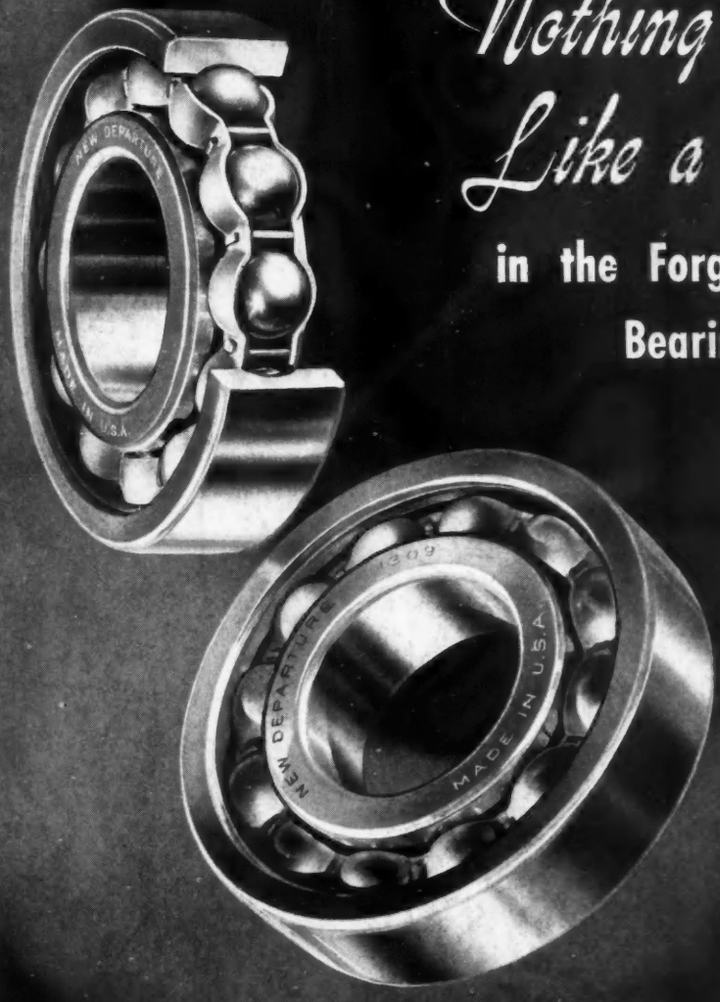
in the Forged Steel Bearing



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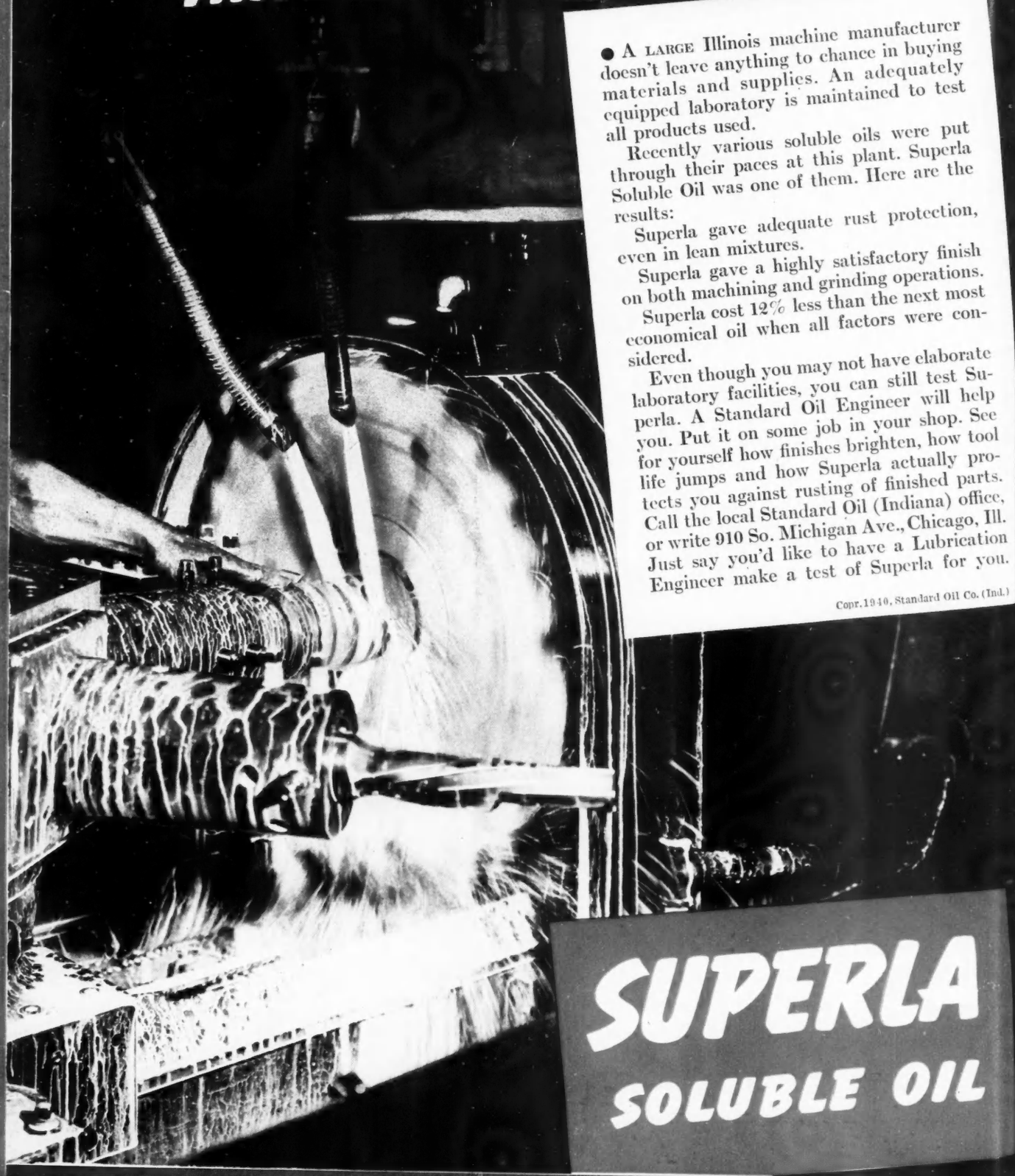

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Semi-Monthly

Volume 83 Number 7

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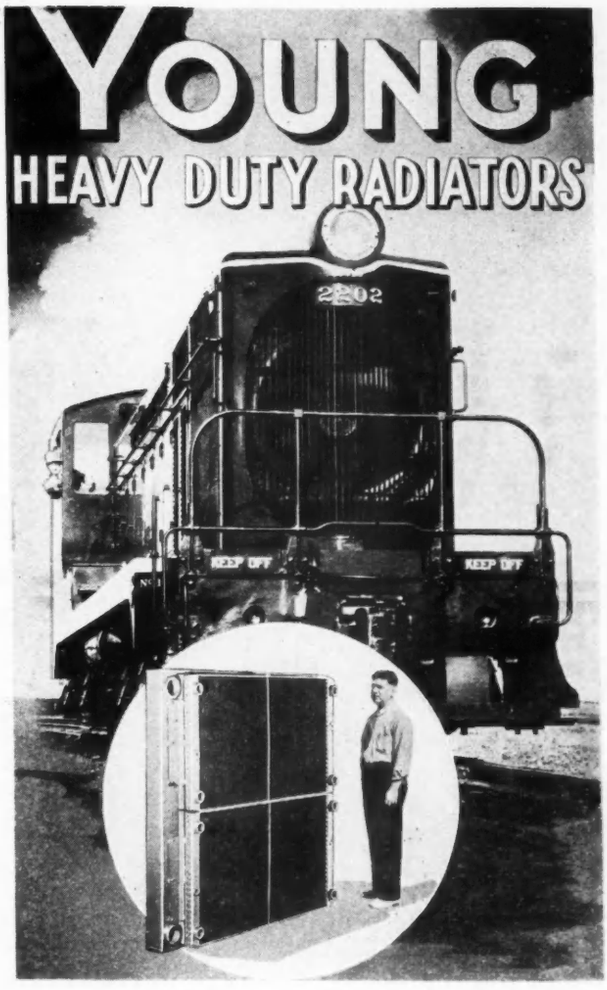

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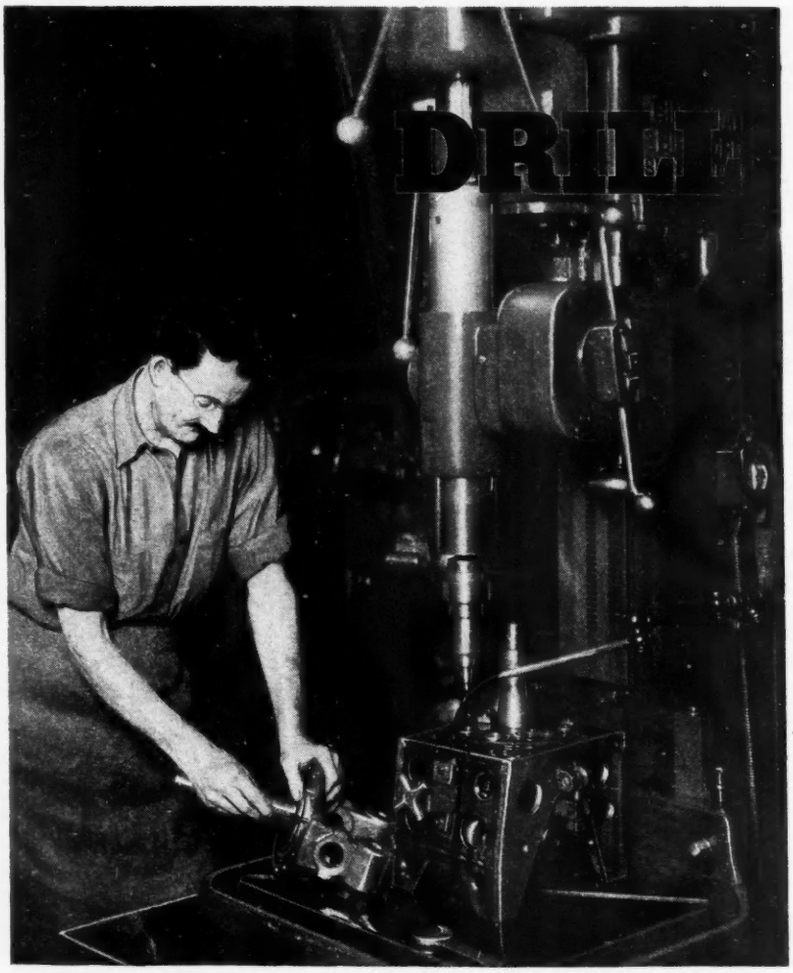

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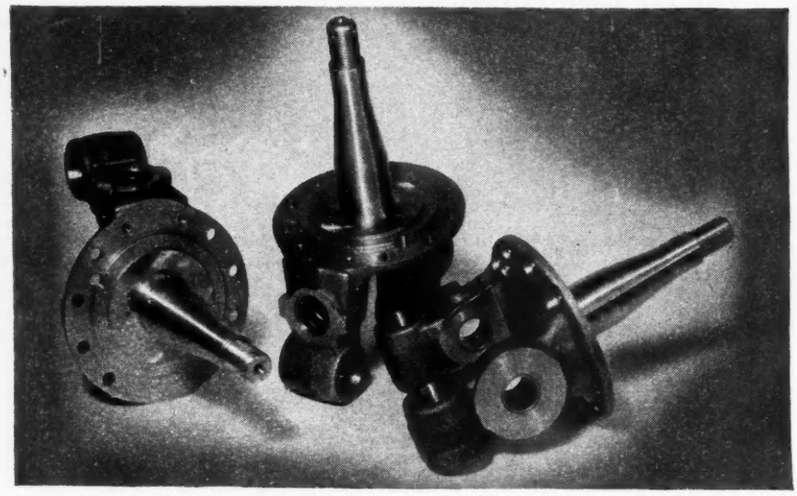

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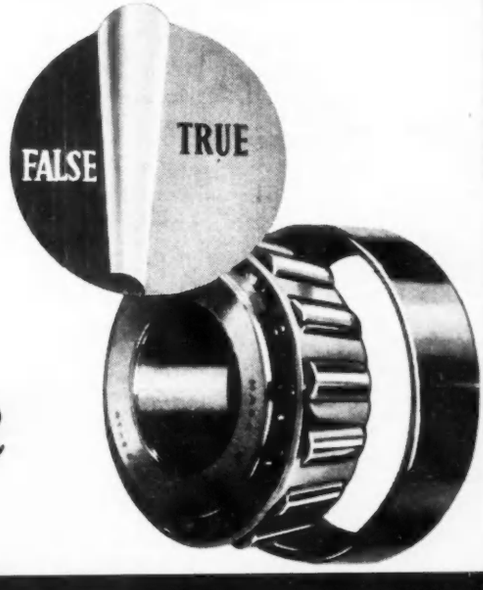

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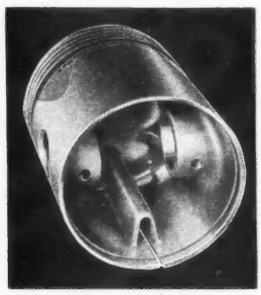

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IN THIS ISSUE . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 83 October 1, 1940 Number 7

Expert Warns of Sabotage Fire Threat

With America's industrial structure already being weakened by fire at the rate of more than $10,000,000 a month, and with the threat of "speed-up" and sabotage fires greater than at any time in American history, this year's Fire Prevention Week from October 6 to 12 has a far greater significance than ever before. This is the burden of a statement issued this month by John Kidde, New York engineer who has spent many years studying fire protection methods.

No country that accepts foreign war orders can hope to escape sabotage fires, Mr. Kidde points out. Factories engaged in our own national defense orders are also the target of saboteurs and foreign agents, and because these "torches" are better organized and more ingenious than ever before industry must perfect its fire defenses lest its military defense program bog down. With their surprising knowledge of America's interdependent production set-up, saboteurs can tie up entire industries by putting the torch to a "bottle-neck" plant, or merely to a department performing a single vital operation on a product.

The effectiveness of fire as an industrial wrecker is shown in the tactics of European bombers, Mr. Kidde points out, for incendiary bombs are used even more widely than high explosives, and their targets are almost always factories. And the "bombs" of saboteurs—ingenious devices such as self-obliterating lead tubes containing fire-setting chemicals—have an even better chance of achieving their purpose because they are unexpected.

Speeded up production is another source of fire danger which factory men should watch, according to Mr. Kidde. During periods of frantic war preparation when new plants are put up almost over-night and management concentrates on maximum output normal precautions are often ignored and fire hazards are allowed to exist.

Although most of America's industrial fire loss so far has been the work of "General" Carelessness Kidde feels that many manufacturers depend upon antiquated extinguishing equipment, which has been rendered obsolete by vast changes in our industrial production methods. For example, since the World War—the last great fire-scare period—millions of new fire hazards have come into use—millions of gasoline-burning trucks, tractors and material-handling machines, billions of gallons of combustible fuels, and a tremendous amount of flammable liquids and synthetic products. Many plants where such hazards exist still depend on extinguishers which are literally of World War vintage, when statistics clearly show that flammable liquids are involved in the majority of sabotage fires.

Synthetic rubber, lacquers, high-test gasoline, diesel fuels, new solvents, chemicals used in plastics, synthetic finishes, acetate and rayon yarns, etc., and the infinite variety of solvents and petroleum products, are cited as a few of these materials and processes which have posed new problems in fire protection in the last few years. And when one adds to these munition plants, airplane and engine plants, and a host of chemical factories all working at top speed, the opportunity for crippling fires is immensely broadened.

Manufacturers are urged by Mr. Kidde not to embark on "witch-hunts" among their employes, but rather to follow three simple steps. First, institute a campaign for top notch plant housekeeping, to eliminate unnecessary hazards and careless habits. Second, teach employes how to fight fires, organize fire brigades and stage frequent fire drills. Third, analyze the hazards in plants and warehouses and adopt the most advanced fire safeguards. In this last step, the advice of insurance men, fire department officials and manufacturers of fire protection equipment can be of great help.

GENERAL

Defense Program in Action **Page 283**

In this article William S. Knudsen gives a graphic picture of the situation as it appears today in our National Defense program.

QUALITY CONTROL

Pace Set by Quality Control **284**

Quality control is a dominating factor in today's manufacturing procedure. Here is shown how it is made to fit into the picture of the important organizations.

NEW CARS

1941 Models

With the fall months come the new offerings in the automotive markets and in this issue are described a goodly number of them.

Packard 298 **Cadillac 300** **Oldsmobile 302**
De Soto 304 **Nash 306** **Willys 307**
Chevrolet 308 **Ford Line 310** **Chrysler 314**

SUPERFINISH

Precision Machining **385**

The procedure for high finish of metal parts particularly as applied to the automotive field is described here.

Since 1913 all issues of AUTOMOTIVE INDUSTRIES have been indexed in the *Industrial Arts Index*, which can be consulted in any public library.

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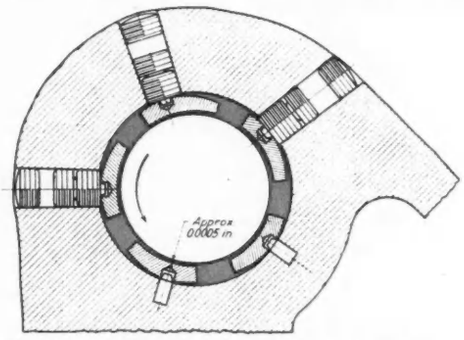

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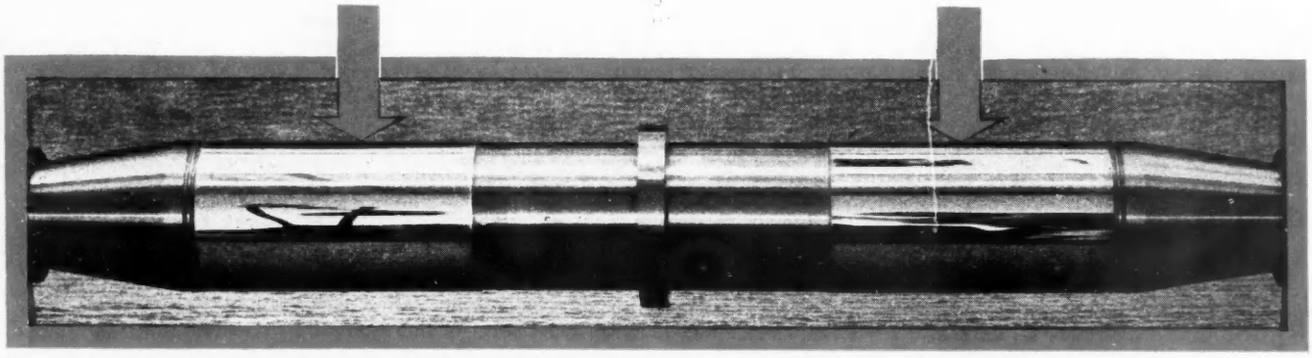

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NATIONAL DEFENSE ISSUE

AUTOMOTIVE INDUSTRIES

Published on the 1st and 15th of the month

Vol. 83, No. 7
October 1, 1940

Defense Program in Action

Defense load superimposed on the regular business load of the country in order to take up the slack and then adjust it if necessary

By WILLIAM S. KNUDSEN*

IN STARTING our work in Washington it became apparent that we had to decide on our policy of operations, which meant simply to decide whether we were arming for war or for defense. I call this a most important point in our work, as war regulations are entirely different from peace regulations. We had large manufacturing facilities not fully employed and we had a surplus of help in the large number of unemployed variously reported at from five to eleven million. Consequently it seemed advisable not to attempt to place industry on a war basis if speed could be obtained without doing so. We decided to superimpose the defense load on the regular business load of the country in order to first take up the slack and then adjust it if necessary.

It was decided to spread the load of the defense program and to the greatest possible extent, employ private industry, business, finance and engineering in order that the program would be of national scope and the greatest possible speed obtained on deliveries.

The first step was to obtain from the Army and Navy a tentative list of their requirements in order that the items could be classified and studied. It should be remembered in connection with this that both the Army and the Navy had been for years dealing with very small appropriations and, consequently, small quantities of equipment, there being very little money left after the men had been housed, fed and clothed. The decision was made to tie the schedule up to the appropriations so that it would release accordingly. Schedule "A" covered the appropriation for which funds were made available July 1, and Schedule "B" for funds which actually became available September 10. The only control which at first was asked was that contracts over $500,000 be made subject to clearance by my division, the object being to spread the work and have it done by responsible people. The extent to which this has been carried out can be judged from the fact that 73 per cent of the Army material has been placed and over 80 per cent of the Navy material has been placed on Schedule "A," the appropriation made available July 1. We have started releasing material on the second appropriation of September 10, but except for the ship program, not in very great amounts as yet. The thought behind this work is to get the factories working on the tooling, which is the all-important part, and get materials ordered so that the tools and material may meet at the earliest possible date and produce articles. In most cases, where additional facilities were required, we were able to plan for Schedule "A" and "B" combined, which saved some time. Naturally, everything was not smooth sailing. Design and specifications of finished articles were sub-

(*Turn to page* 184, *please*)

* From an address delivered before the United States Conference of Mayors.

GENERAL

Production

By Joseph Geschelin

Interchangeability of similar parts as a basic principle of mass production has been responsible for the emphasis upon quality in every branch of automotive manufacture. Although this has been the case from the very beginning of quantity production, the interpretation of quality has been consistent with the recognized limitations of the process at any given time.

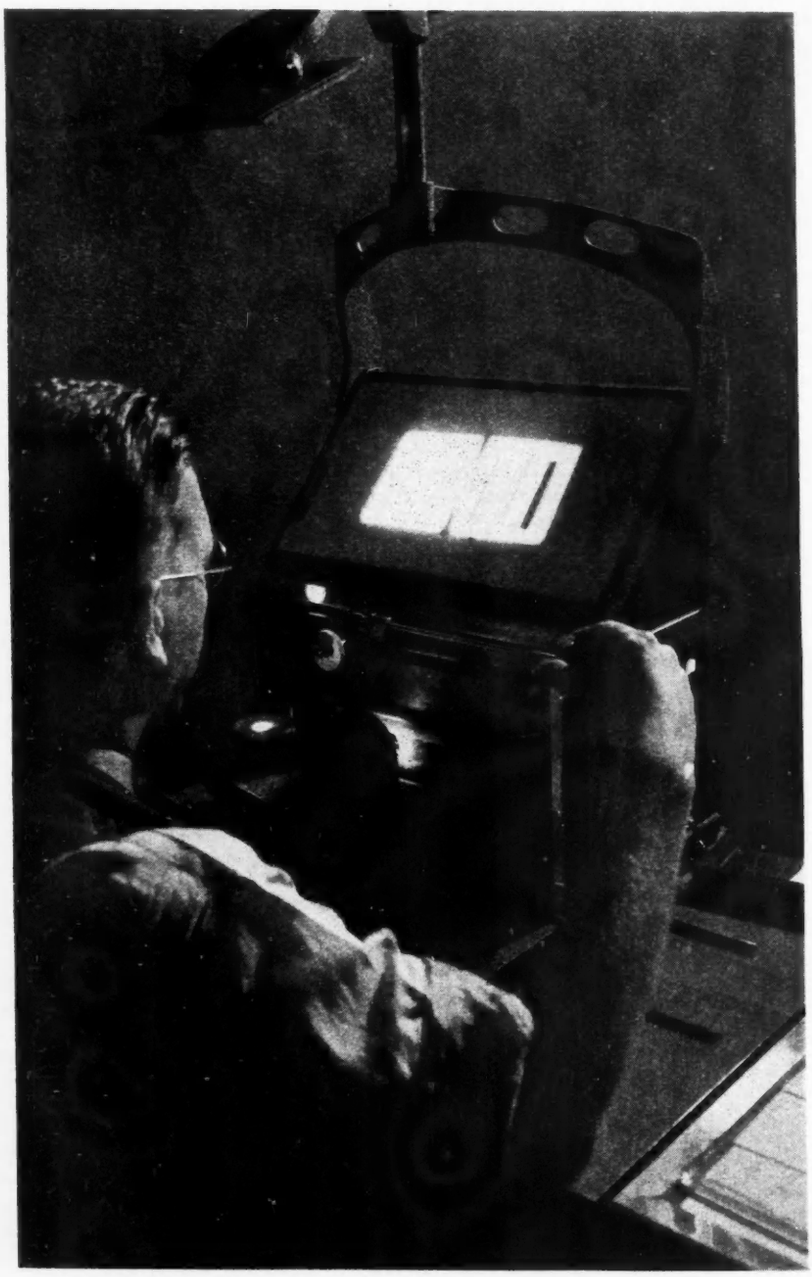
Strictly speaking, the requirements of interchangeability have been satisfied by adherence to a definite tolerance range which could be adjusted in keeping with the ability of existing processes. Even so, certain types of parts and sub-assemblies never were strictly interchangeable since they had to be graded and used selectively. This has been particularly true of pistons and rod assemblies where selection has taken into account not only minute gradations of size but of matching weight as well.

More recently the concept of quality has matured in an almost revolutionary manner due to the increasing emphasis upon "quietness." In all probability, this was born of the demand for improved transmissions, marking the exodus of noisy second speed. With the application of scientific method to this problem it was found that quietness is a relative quality; moreover, it was soon discovered that each major element of the vehicle had an effect upon its neighbors, ofttimes masking some other noise-producing source.

Thus began a cycle of research which started with the transmission but took the investigators around the complete circle—rear axle, engine mechanism, fan, muffler, body, suspension elements, and the like. This work focused attention upon surface finish, upon finer clearances, led to improved methods of making gears. In its wake came the host of advanced techniques now in general use.

At first glance, the obvious impression of quality control is the comparatively simple function of the inspection of fabricated parts. In reality that is but a minor part of the real story. Upon reflection it must be appreciated that progress has stemmed from the availability of improved processes and improved machine tools capable of providing the background for precision.

But precision is limited by the ability to measure it. So there must



Viewing screen for the examination of foundry samples analyzed in the spectrographic laboratory in the Ford Rouge plant. This is a routine procedure controlling the production of steel castings.

This magnetic thickness gage is employed by Pontiac for checking cylinder wall thickness. The intensity of the magnetic field as varied by wall thickness is read directly in graduations of 1/64 in. on the calibrated scale.

Pace Set by Quality Control

In recent years applied statistical methods in quality control have gained some prominence and merit the attention of management executives. These methods are of particular value in mass production on highly repetitive operations where sampling may be employed to reduce the cost of inspection. Incidentally, such methods are indispensable in the inspection of parts which can be tested only by destructive procedures. For a working knowledge of statistical procedures we refer you to the following bibliography:

"Statistical Method from the Viewpoint of Quality Control" by W. A. Shewhart (1939).

"Economic Control of Quality of Manufactured Product" by W. A. Shewhart (1931) published by D. Van Nostrand.

"The Application of Statistical Methods to Industrial Standardization and Quality Control" by E. S. Pearson (1935) British Standards Institution.

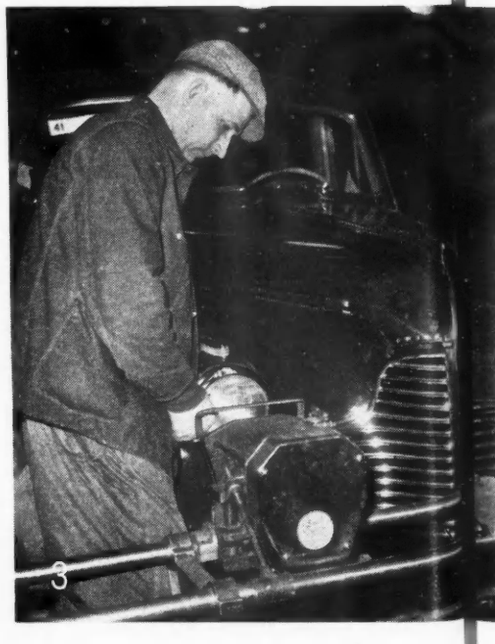
"1933 A. S. T. M. Manual on the Presentation of Data".

We recommend a study of this literature and urge that serious attention be given to the preliminary analysis of current inspection records with the aid of the "control chart" described by Dr. Shewhart.

be a parallel development of instrumentation to provide practical and positive means for measurement. As we get better instrumentation, it becomes easier to control the process of metal cutting; it becomes easier to eliminate rejects and spoilage. And finally, these methods pave the way to still further improvement.

Thus we reach a stage wherein it is quite difficult to isolate the relationship of the basic elements of the problem. It poses some pertinent questions—Do the demands of the users force advances in the art of machinery development; or do the machinery builders anticipate the need for better quality. In all probability there is a positive answer to both questions but on the record it is evident that a combination of the two is responsible for the major advances made in the past ten years.

Consider machine tools. Doubtless much of the current advance can be traced to the drive for increased productivity which followed the intro-



duction of the "hard" cutting tool materials typified by the cemented-carbides such as Carboloy, and by the cast metals such as Haynes-Stellite J-Metal. In attempting to take full advantage of these new materials it was found necessary to change the entire philosophy of machine design. This led to heavier, more massive machines with greatly increased motive power, capable of higher speeds and faster feeds. This, in turn, promoted the adoption of anti-friction bearings and precision spindles and more rigid tool holding devices.

Net result of the emphasis on productivity was a general improvement in the rigidity of machinery and with it not only better quality but the ability to maintain it indefinitely.

On the other hand, there has been an uninterrupted train of betterment in materials. Apart from improved physical properties, the newer materials have kept pace with the need for better machinability and better surface quality. These

1. Electrolimit gage is used at Buick for final inspection of outside diameter and grading for engine assembly.

2. Buick subjects all steering knuckles, knuckle supports, and steering arms to a Magnaflux inspection to assure freedom from minute seams and cracks.

3. Focussing headlamps on the final assembly line at Buick, using Guide headlamp testers.

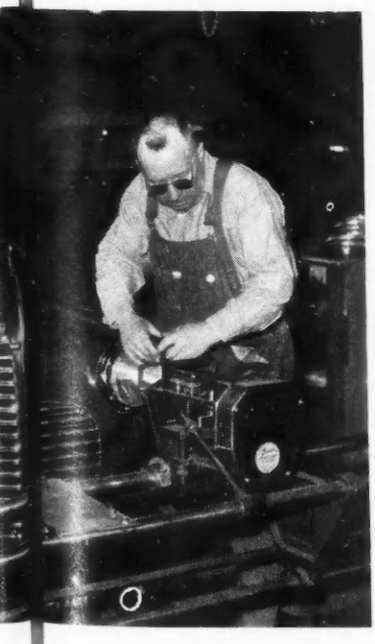
attributes have aided in closing the circuit of quality in its many ramifications.

To summarize the advances in machine tools concerned with improved quality, we may point briefly to the following:

1. trends in grinding machines and precision grinding wheels
2. advances in precision boring
3. current status and future trends in honing
4. forging and coining presses
5. introduction of surface broaching
6. general adoption of hydraulic mechanism and electric controls
7. ease and safety of machine operation
8. built-in instrumentation for automatic sizing
9. greater ruggedness and rigidity

Since the subject is far too vast to treat in detail, we shall have to be content with this topical reference. Similarly, instrumentation is too broad a subject for full discussion and will have to rest with a brief high-spotting, as follows:

1. increasing adoption of industrial X-ray for investigating the structure of metals, the character of hidden flaws
2. use of Magnaflux equipment for detecting surface imperfections
3. Profilometer, Profilograph, and the Brush machine, for the measurement of surface quality (in microns)
4. Johanssen blocks in actual production
5. Sheffield gages providing a multiplication of 1000 to 1, leading to a positive grading of tolerances within a relatively wide band of identification
6. wide use of electric gaging as exemplified in the Pratt & Whitney Electrolimit gage
7. automatic analysis of the composition of metals and alloys as well as positive identification of traces of impurities by means of the Spectrograph
8. color analysis with the Spectrophotometer
9. production uses of the microscope
10. accurate checking of contour and profile of small elements by devices such as the Jones & Lamson comparator
11. apparatus for acoustic analysis
12. the variety of new instrumentation for precision gear laboratory checking—for lead error, for involute profile, for tooth thickness and tooth spacing, etc.
13. equipment and instrumentation for block testing engines



Right now we are in a stage of development wherein measurements of scientific character have been brought within the realm of commercial application. And with measurement of the order of a millionth of an inch, it has been found desirable to operate under controlled conditions of temperature and humidity. Thus we find a widening use of air-conditioned spaces for housing such operations. Among the earliest applications of controlled atmospheric conditions are: cylinder block precision boring and honing at Ford; piston grading and piston and connecting rod assembly at Buick; piston grading at Plymouth; and others. In addition, there is the growing tendency to isolate certain operations, particularly fine finishing and activities where abrasives are employed.

Several excellent examples of this may be cited. First is the set-up at the Detroit Division of G.M. Diesel where the fine grinding operations on injector parts are isolated in a self-contained department to prevent the entry of abrasive dusts into the machine shop. Then there is the relatively new set-up at Plymouth where the final operations on pistons and rods are handled in an enclosed department to assure a clean atmosphere for precision operations.

Seeing, as the partnership of vision and lighting, is a concept which has gained wide prominence wherever quality is important. With it has come the general adoption of improved lighting, the utilization of modern high-intensity light sources and scientifically controlled illumination. Improved seeing is emphasized on inspection benches, on production lines, on final paint lines, on final car inspection lines. The investment has paid dividends in higher levels of quality, in the reduction of spoilage and rejects.

Finally, quality is intimately related to many technical processes in which the control is inherent and self-checking in effect. Among examples of these are —electric welding machines with electronic timing devices for controlling weld quality; gear cutting machines; applications of Superfinish; the balancing of pistons and rods and crankshafts; foundry metal sampling; electroplating; and the like.

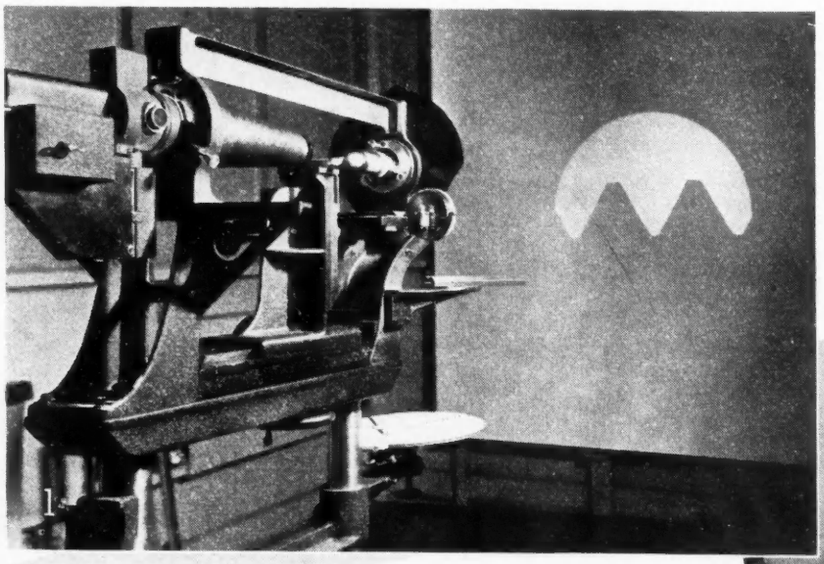
It is an interesting commentary that the philosophy of quality control is unique with practically every organization. This is quite logical when one considers the variable factors which enter into the situation. Consider that quality control depends upon the nature of the product and its utilization; the element of productivity or quantity; the cost level; competitive situation; etc.

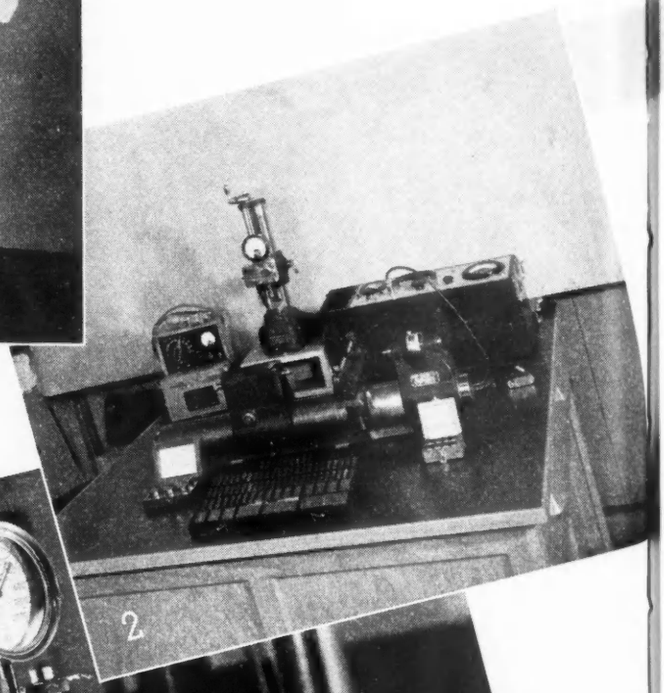
Consequently, in support of the generalized picture given in the foregoing, we present a brief high-spotting of case studies in a few selected but typical plants in the automotive industry. These case studies are supplemented by the pictorial section which covers many unique and, it is hoped, outstanding inspection operations.

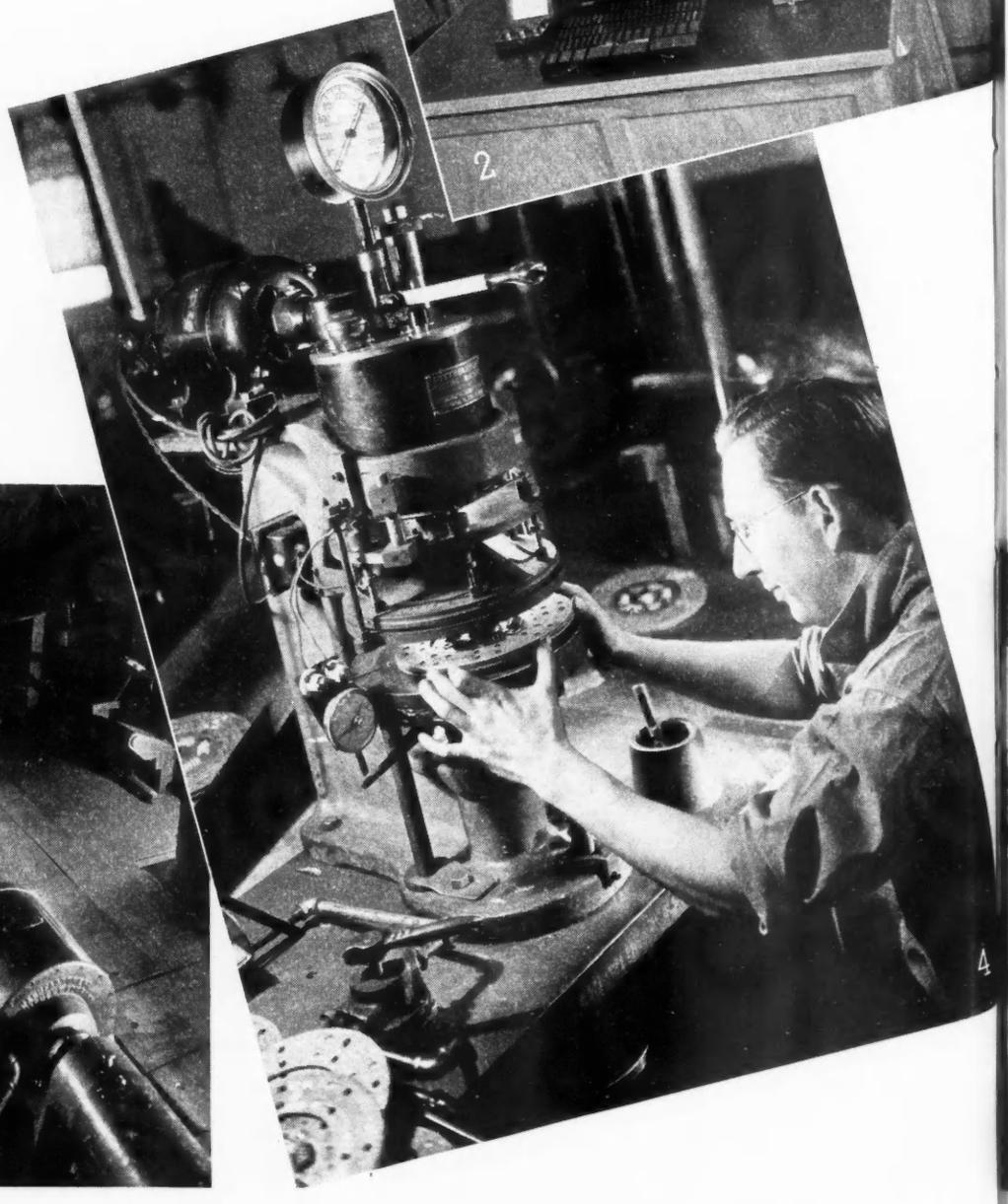
Borg & Beck

At Borg & Beck the inspection routine follows the generally accepted practice of receiving inspection of all purchased materials, floor inspection of parts in process, a suitable sampling check of finished parts, and 100 per cent inspection of final assemblies.

Floor inspection serves more as an information bureau on material in process than as a production check, since the actual responsibility for quality is vested in the production department and its supervisors. Each







MEN AND MACHINES

1. Bausch & Lomb projector is an important part of the inspection equipment at Caterpillar.

2. Typical of the scientific instrumentation employed by the inspection department at Caterpillar Tractor is this group comprising — the Electrolimit gage, Abbott Profilometer, Pratt & Whitney Super-Micrometer, Johansson blocks, and other master gages.

3. Clutch driven plate inspection machine at Borg & Beck for 100 per cent inspection of driven plate assemblies. The assembly is mounted on a ball bearing rotated arbor, the flange compressed between two plates. The front plate then is retracted to a point where it turns freely, readings of drag release and friction lag read off the indicators.

4. Another Borg & Beck 100 per cent inspection of driven plate assemblies. This is a power-driven Brinell machine to check the cushion, thickness, and parallelism of the flange under load.

5. In addition to the many individual inspection operations at Caterpillar, a further check on accuracy is made by partially assembling mating parts and inspecting the alinement of the sub-assembly, as in the case of this huge transmission case.

operation has a full set of gages for rapid inspection to the prescribed requirements and production operators are instructed not to proceed when difficulties or interferences arise until supervision can correct, and approval to continue is obtained. Gages in use are designed with proper consideration for the importance of the dimension measured and its relation to subsequent operations and final function.

Assembled units are line produced and 100 per cent inspected, with inspection operations and equipment arranged to obtain the necessary quality control by concentrating on the important and essential requirements.

Due to the repetitive nature of quality control in this plant, the management repeatedly stresses the role of the inspectors in assuring consumer acceptance, thus maintaining the interest of these men in the functional character of their tasks. The relation of quality control to costs and the production process has been given due consideration with constant emphasis on the human equation which persists in highly mechanized operations.

Caterpillar Tractor

In Peoria, Caterpillar has three factories, in close proximity to one another. These are the Tractor and Road Machinery factories and the Foundry. The inspection organization in these factories is unified and so established as to assure uniform standards throughout all three plants, irrespective of product.

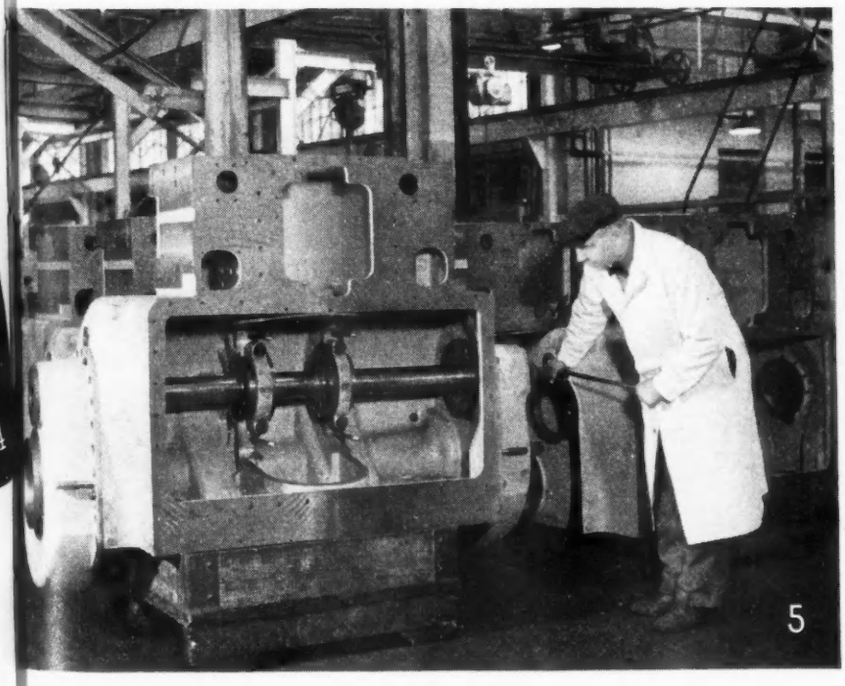
Assisting the chief inspector is an assistant, who, together with the chief inspector, supervises the inspection in all three factories. From this point in the inspection set-up, the supervision is further carried on by six inspection general foremen, assigned to specific parts of the factories and assisted by the necessary number of inspection foremen, who see that the inspection work is properly carried on. Briefly, the assignment of these six inspection general foremen is as follows:

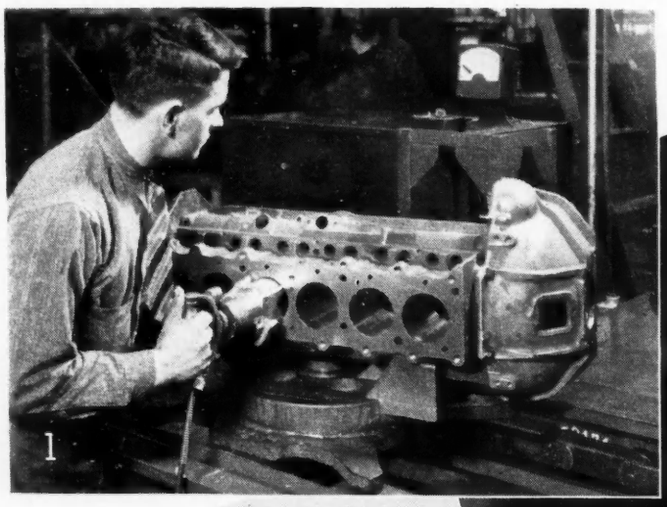
The tractor factory, the largest unit, is supervised by two of the general foremen. One has charge of what might be described as 80 per cent of all machine work and 50 per cent of all assembly. The other has charge of the remaining machine work and assembly, supervises the tractor factory Receiving Inspection, and indirectly is in charge of the salvage work and welding in all three plants.

The inspection work in the road machinery factory is directly supervised by an inspection general foreman, while the fourth inspection general foreman is in charge of foundry inspection as well as the inspection of all castings purchased from outside vendors.

The inspection organization on the second shift of all three factories is under the direct supervision of an inspection general foreman, who reports directly to the chief inspector. Similarly, all inspection on the third shift in the three plants is under the direct supervision of a sixth and last inspection general foreman, who also reports directly to the chief inspector.

The number of foremen assisting these general foremen varies, and depends on the size of the territory covered by the general foremen and the type of work supervised. This number ranges from one foreman in





one part of the plant to as high as six foremen in another part of the plant.

Just as the number of foremen working with a general foreman varies, so does the number of inspectors per foreman vary. One of these foremen has general supervision of the quality of welding in all plants, and, as a free lance, works in any and all plants. He may be found working on the first, second, or third shift, and oftentimes part time on one shift and part time on another shift. On the other hand, some of these inspection foremen have as many as 27 inspectors to supervise.

For many years, the inspection work has been carried on through line inspectors working in conjunction with machining and assembly operations and final inspectors at the ends of the line checking varying percentages of the work. This is gradually being changed to the progressive type of inspection where one man watches the work as it is carried on so that when it comes off the line it is ready for its final use. The application of this type inspection depends largely upon the method and lines of manufacture. This holds true in the foundry, machine shops, and erection or assembly shops alike.

Inspection work at the Caterpillar Tractor Company plant in San Leandro, Cal., is carried on in a manner similar to that in the Peoria plants, with a chief inspector directly in charge of the inspection work.

Buick

At Buick the inspection department, which is under the direction of C. N. Ofield, parallels the organization scheme of the production department in every respect. Thus each plant division has an inspection supervisor whose responsibility is closely akin to that of the superintendent of the production division with whom the former cooperates very closely. Under the supervisor are foremen of inspection with their groups of inspectors.

Basic criterion of Buick quality control is acceptance of the finished product, whether it be a machined part or a complete assembly. The responsibility for quality and freedom from rejects is vested with the manufacturing department which has control of all intermediate stages, sub-assembly and final assembly. This cooperative scheme simplifies the inspection procedure, makes it possible to concentrate upon the finished product.

The inspection department is responsible for the quality of all incoming materials in the form of raw materials and finished parts or attachments—all of these being required to clear the incoming inspection department. The inspection department also controls

1. Cylinder bores are checked with the Electrolimit gage at Chevrolet.

2. Page the physician! Listening to the engine on the block test at Chevrolet with the aid of a stethoscope.

3. Chevrolet new car conditioning department with inspectors taking charge of final adjustments including engine tuning with the Sun motor analyzers.

the checking of all tools and jigs and press dies before they are released for production use.

One of the most important functions of quality control at Buick is the sample checking of all parts and units and accessories at the start of each new model year to assure conformity to engineering specifications.

Perhaps the most important attribute of inspection here is its close cooperation with the production division, smoothing out problems of tolerances and surface quality and performance in the best interest both of the consumer and the producing organization.

Chevrolet

Due to the large number of plants in the Chevrolet organization, it would be quite a task to picture the activity of the inspection department in its every detail. For this reason, we have confined ourselves to a brief sampling of the procedure in one of the major units—the gear and axle plant in Detroit.

The inspection department in this plant consists of a chief inspector, his assistant, and a foreman in each department. Each foreman has a free-lance quality man called a "check-up" man whose function is to double-check on the work of the regular inspectors. He is provided with a kit of special gages and instruments, used only by himself, thus making it possible to check on the condition of the gages used by the inspectors. In addition, this check-up man inspects all of the gages used in his department, using master gages for the purpose.

Gages with close limits are checked every two hours to detect signs of wear or change in adjustment. Other instruments, such as indicators, balancing machines, hardness testing machines, Durometers, etc., are calibrated at regular intervals to assure a constant level of quality control.

Coming to the product we find that all operating parts such as bearings, splines, brake shoes, brake drums, king pins, and in general all dimensions pertaining to wheel alignment relations are inspected 100 per cent. The various sub-assemblies and assemblies are inspected to assure the correct installation of parts and are checked for significant adjustments and noise. Finished axle assemblies are inspected for torque tube and wheel alignment, by means of special gages.

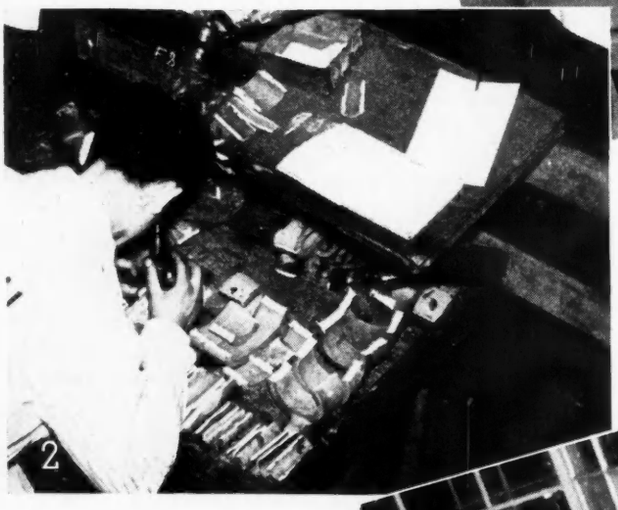
An unusual feature of the set-up is an organization of a few highly skilled free-lance inspectors with a roving commission throughout the entire plant. These men make excursions, unannounced, into the various departments and double check on inspection by rechecking a sampling of the work that has been passed by the regular inspectors. It is obvious that the activity of these men, coupled with the work of the departmental check-up man, keeps the entire staff on its toes and contributes in a major degree to the unfailing maintenance of the established quality standards.

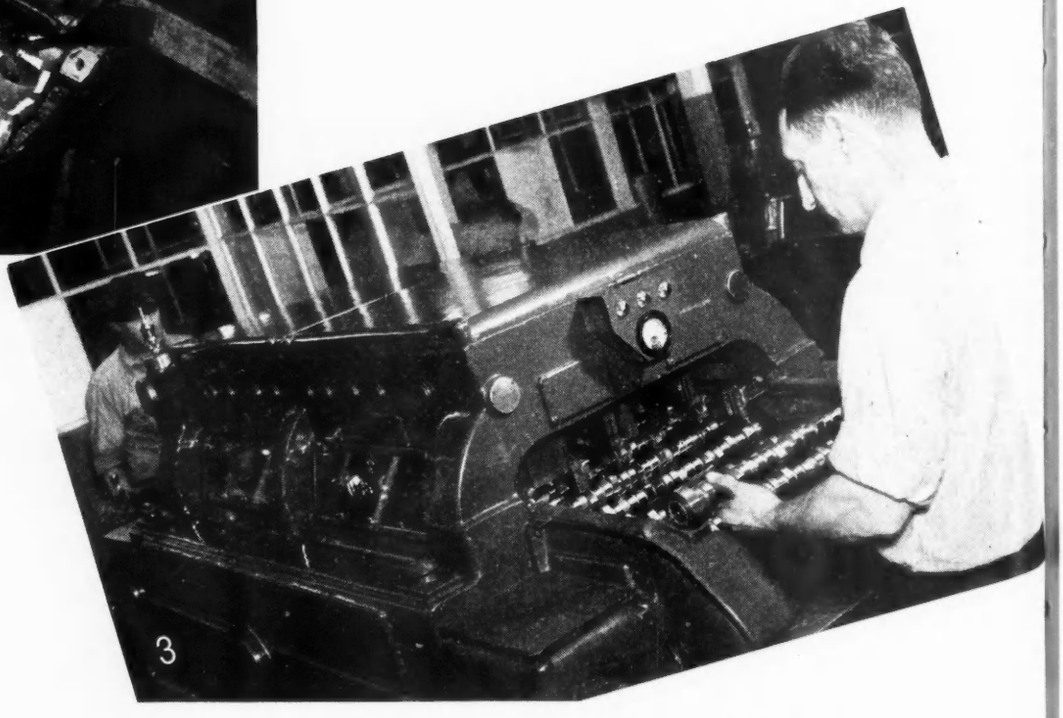
Federal-Mogul

One of the most important producers of precision bearings for automotive and aircraft engines, Federal-Mogul, rests the structure of its quality control upon the broad base of special production equipment, unique inspection devices, scientific control of non-ferrous metallurgy and foundry practice. Basic functions of the producing organization are supervised by a comprehensive quality control set-up.

The inspection department in all of its manifold activity is under the direction of L. C. Felts, quality manager. His lieutenants are—the chief inspector, assistant chief inspector, and three departmental foremen of inspection. The plant has 11 production departments, each of which is patrolled by inspectors in the approximate relation of one inspector for about 30 machines. Finished parts clear through the final inspection department where they are checked 100 per cent with the most modern inspection devices.

In keeping with the practice in other plants in the industry, where precision is the order of the day, at Federal-Mogul the burden of the responsibility for the maintenance of quality standards and freedom from rejects is vested in the production department. To this end, each operator keeps a careful watch on the output of his machine, checking the work at frequent intervals with instrumentation quite similar to that employed by the inspectors.





1. Measuring in the millionths of an inch is a routine matter at Ford with this Profilometer. Ford is said to have used the first instrument of this kind made for industrial application.

2. Samples of each batch of non-ferrous bearing castings from the Federal-Mogul foundry are fractured, examined under the microscope for characteristic structure, before acceptance of any heat.

3. Tyical of the inspection machines that "see" and "think" automatically, developed and built by Ford, is the automatic inspector for camshafts shown here. The machine automatically gages 25 different measurements, some with a tolerance of 0.00025 in., marks off-tolerance at points where they are out, discharges accepted camshafts in one chute, rejects in another.

4. Special inspection machine for measuring the circumference of engine bearing shells under pressure at Federal-Mogul. This view shows the inspector adjusting the deflection beam for the proper pressure for testing.

As a basic part of this program, the departmental inspector is required to check the first piece off each machine at the beginning of each shift and at other times whenever there is a change of operators during the course of any shift. This assures the proper setting and tool adjustment on every operation, provides the machine operator with a standard base.

Apart from the metallurgical control of the foundry operation where castings are produced for over 500 different parts, the inspection department maintains a control laboratory which checks castings from each batch. A specimen of each part is crushed and checked for structure, the acceptance or rejection of an entire heat being dependent upon the outcome of this procedure. In addition to the test for structure, parts are checked for hardness and rough dimensions, which are considered of fundamental importance in the succeeding machine shop operations. All foundry output as well as material purchased from outside vendors clears through the receiving inspection department before being released to the factory.

One of the most important of the special inspection procedures in use here is that of measuring the circumference of half bearing shells. This is done in a special machine which makes the measurement under a definite pressure based upon the deformation of the shell under actual service conditions in an engine. This pressure is adjusted through a deflection beam member which is calibrated for each test in accordance with the standard noted on the blue print. This calibration is expressed in terms of deflection on a dial which communicates with the deflection beam.

With the growing specification of ultra-fine finishes on aircraft bearings, the company has adopted the use of the Abbott Profilometer as the arbiter of surface finish measurements in accordance with the user's requirements.

Finally, the results of quality control are expressed in the so-called "confession" system in which the daily scrap is charged to individual departments, the scrap report being "autographed" by the inspector in charge and the production supervisor, thus allocating the responsibility for spoilage. The scrap report is made out daily for the foundry and for each of the 11 burden centers, the latter having individual scrap containers which are delivered to the foremen every morning and displayed on a bench for scrutiny by the offending operators.

Ford

Quality control at Ford touches on so many kinds of industrial activity under one management that its ramifications extend beyond the usual activities of a passenger car builder. Scientific developments have been given so free a rein that here one will find a wide use of X-ray diffraction, Spectrographic examination of foundry metal samples, application of the Profilometer for surface finish checking, and an interesting variety of automatic inspection machines exemplifying mechanisms that think, and see, and feel. Most important—all of these are production applications of techniques that were but a laboratory curiosity only a short time ago.

One of the outstanding developments is the production use of Johansson gage blocks in addition to their use as master checking devices. For plant use, Ford

1
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1. Noise testing fixture for roller bearings at Packard.

2. One phase of metallurgical control of Pontiac foundry operations is expressed in this view which shows the samples of molten iron taken from every ladle, poured into chill bars which are broken upon cooling. Such samples are analyzed twice a week in the chemical laboratory.

3. Balancing crankshafts at International Harvester engine plant in Fort Wayne.

4. An enlargement comparator at Packard for checking the correct tooth form of hobs.

5. Final inspection of Pontiac cars follows a test run on the quarter-mile concrete track.

6. Weighing and grading pistons and connecting rods at the Indianapolis works of International Harvester.

has 235 sets of Jo-blocks and 491 Johansson internal indicator gages. The Jo-blocks are accurate within two-millionths of an inch.

Recent count shows that the Ford plant has over 38,000 precision gages of every description in V-8 and Mercury production, with at least 6350 gage applications per car. To maintain these gages within established limits of accuracy, there is a crew of 40 precision gage inspectors who make the rounds of every department of the plant every day. They are equipped with kits of master gages and special Jo-blocks with which the inspection instruments are verified to intercept the slightest sign of wear or imperfection.

Among the classic examples of the automatic inspection machines is the piston pin checker which was designed and built by the Henry Ford Trade School. It automatically gages and sorts 2250 pins per hour, detects differences in diameter of the order of 25-millionth of an inch. It also checks for hardness, roundness, length, finish, and taper, sorts the pins into a five-compartment container.

The Spectrograph is a marvelous piece of scientific production testing equipment, used for the spot-checking of metal in the giant iron and steel foundry. Samples of each furnace melt are drawn off at regular intervals, poured into a standard test mold, cooled, then immediately placed in a container and sped through a pneumatic tube to the laboratory 1600 feet away. The sample is checked and analyzed by the Spectrograph and a laboratory report transported by teletype to the foreman within nine minutes. This affords ample time to make last-minute adjustments in the heat to meet the specifications.

International Harvester Company

The inspection department of International Harvester Company's Automotive Division, which covers

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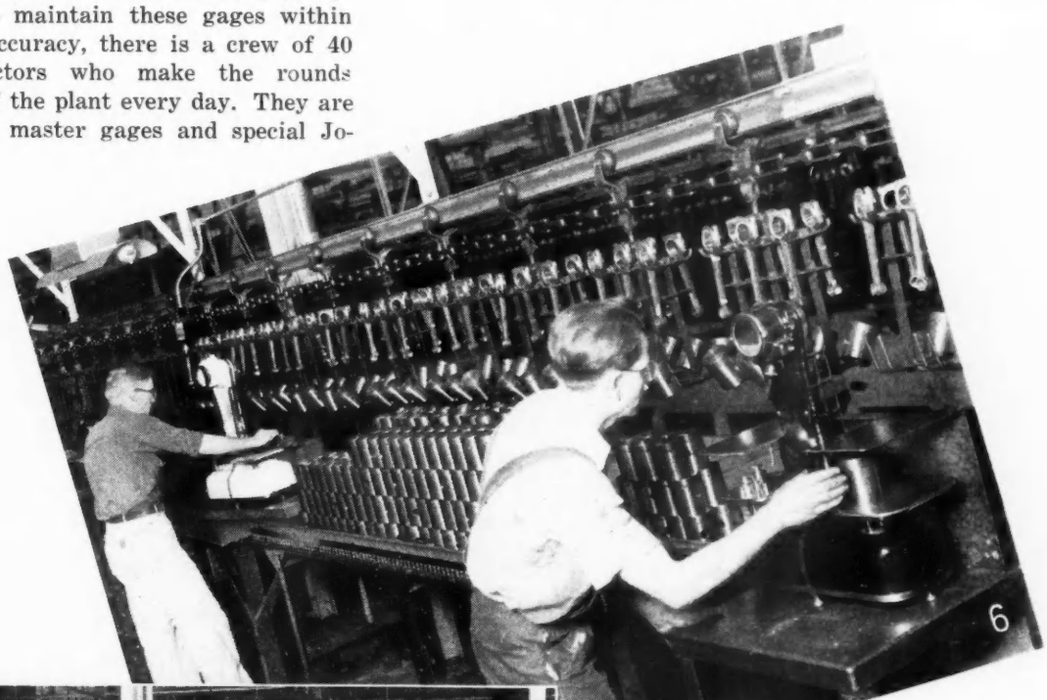

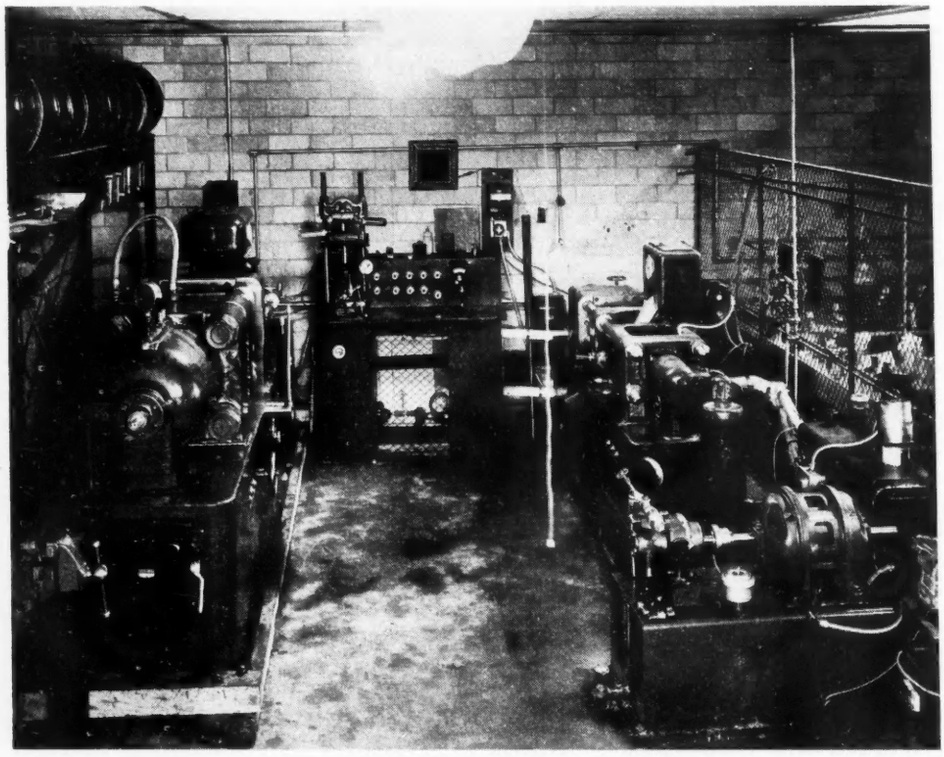

The Hydraulic Press Mfg. Co.'s new plastic laboratory. Equipment includes two standard HPM plastic injection molding presses.

MEN

By H. E. BLANK, JR.

STREAMLINING not only their product but also their thinking, more and more machine tool builders are extending and modernizing their facilities for research. A fine example of the trend in this direction is the recent establishment of a new plastic laboratory by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

Forward-looking HPM executives, knowing that many molders desire to try dies, receive suggestions as to correct mold designs and discuss important molding problems with the press builder direct, saw the wisdom of providing facilities that would permit the plastic molder to test his ideas in an atmosphere of privacy and protection. Another reason why the laboratory was set up was to provide molders or prospective molders with standard molding presses for experimental worg, thereby avoiding the necessity for a person or company to invest in press equipment before experimental work has been completed. Naturally, the laboratory will be used by the company to further development work on its own products.

Installed in the new laboratory are two standard HPM plastic injection molding presses. Both are single nozzle machines equipped with straight-line horizontal hydraulic mold clamps. One press has a capacity of two ounces of material per shot and 40 tons clamping pressure for holding the mold halves closed. The die space mounting for this machine is 14½ by 16 in. Maximum projected area for mold cavities is approximately 20 sq. in. The other HPM press has a capacity of seven ounces per shot with a 200-ton mold clamp. The die space mounting is 16½ by 24 in., and the maximum projected area is approximately 75 sq. in. Each machine has a maximum mold opening (daylight) of 18 in. and a maximum clamp travel of 12 in. Both presses are equipped with radial pumps for generating the hydraulic pressure for press operation.

Other equipment in the laboratory includes a standard

HPM laboratory press complete with attachments. There also is an auxiliary circulating fluid heating system for heating plastics. This heating system is unusual because of its controls for obtaining the correct temperature required for testing the plasticity of certain plastic materials.

PRESENT national defense activity has stepped up demand for close-tolerance-checking instruments that will speed up work without sacrifice for accuracy. One of many companies building such equipment is the Standard Gage Co., Inc., Poughkeepsie, N. Y. This firm announced recently that it is equipping its dial indicators with a new "shock-proof mechanism" and sensitive "low-friction" movement. The indicators, which comply with American Gage Design Committee specifications, also have removable bearings which are separately replaceable.

The "shockproof mechanism" is contained within the indicator body itself, instead of being located in

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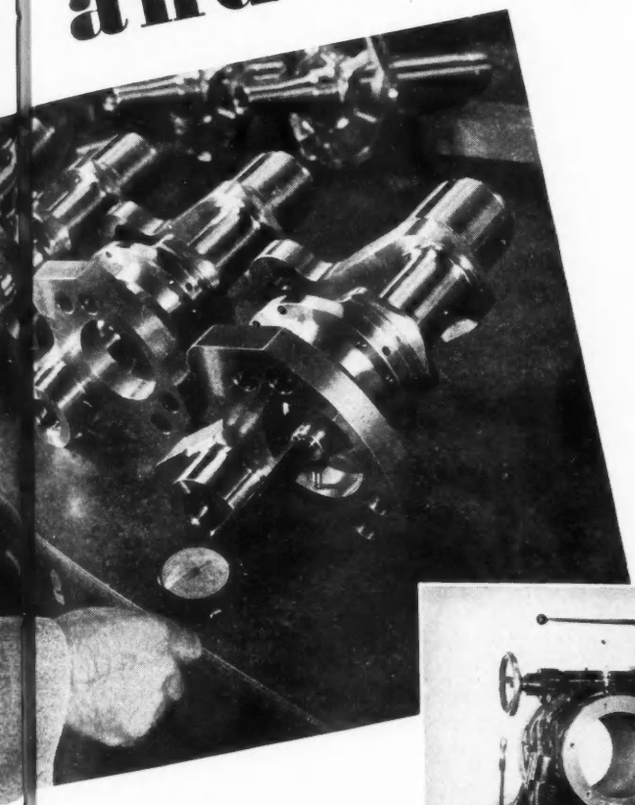
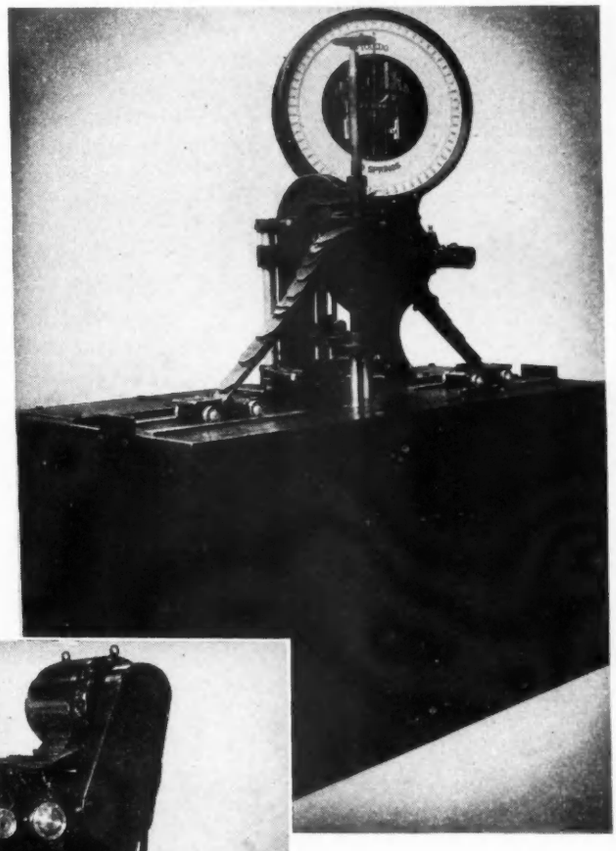
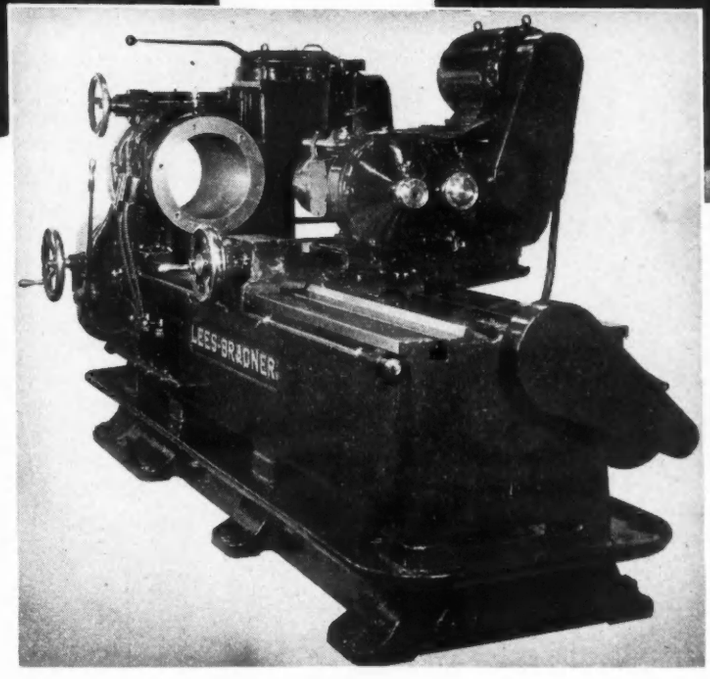
and MACHINES







(Center) Checking inside diameter of a crankshaft damper liner hole at the Pratt & Whitney aircraft engine plant. The dial bore gage being used here is built by the Standard Gage Co., Poughkeepsie, N. Y.

(Above) Equipment built recently by the Toledo Scale Co. for the Ford Motor Co. It is used to test automobile chassis springs and is capable of handling 300 springs per hour.

(Left) Pitch diameter gage manufactured by the Federal Products Corp., Providence, R. I.

(Left) New chucking type thread milling machine built by Lees-Bradner and arranged primarily for the generation of threads on parts such as aircraft propeller blades.

PACKARD this year lays emphasis on new exterior and interior decorative treatment of its cars, including such items as two-tone color combinations, a wide variety of trim combinations in contrasting color and texture of upholstery cloth, or contrasting leather edging or colored leather piping; chrome belt moldings and window reveals, and chrome and plastic instrument panels.

Mechanically the cars remain practically unchanged, except for details. As last year, the line consists of the Packard Six 110 of 122-in. wheelbase, the Packard Eight 120 of 127-in. wheelbase, the Super-Eight 160 and the Super-Eight Custom 180, both of which come in three lengths of wheelbase, 127, 138 5/32 and 148 in. Although the wheelbases remain the same, the over-all length is 5 in. greater in the 110, short-wheelbase 160 and long-wheelbase 180; 5⅝ in. greater on the 120, and 5¼ in. on the long-wheelbase 160. This increase in length resulted from changes in the front- and back-end styling.

Trunk compartment mounting air-conditioning equipment 1941 Packard

All bodies are entirely new, patterned after the form and lines of the smaller body. All models are available with or without running boards, except on the 148-in. wheelbase, seven-passenger models which come with running boards.

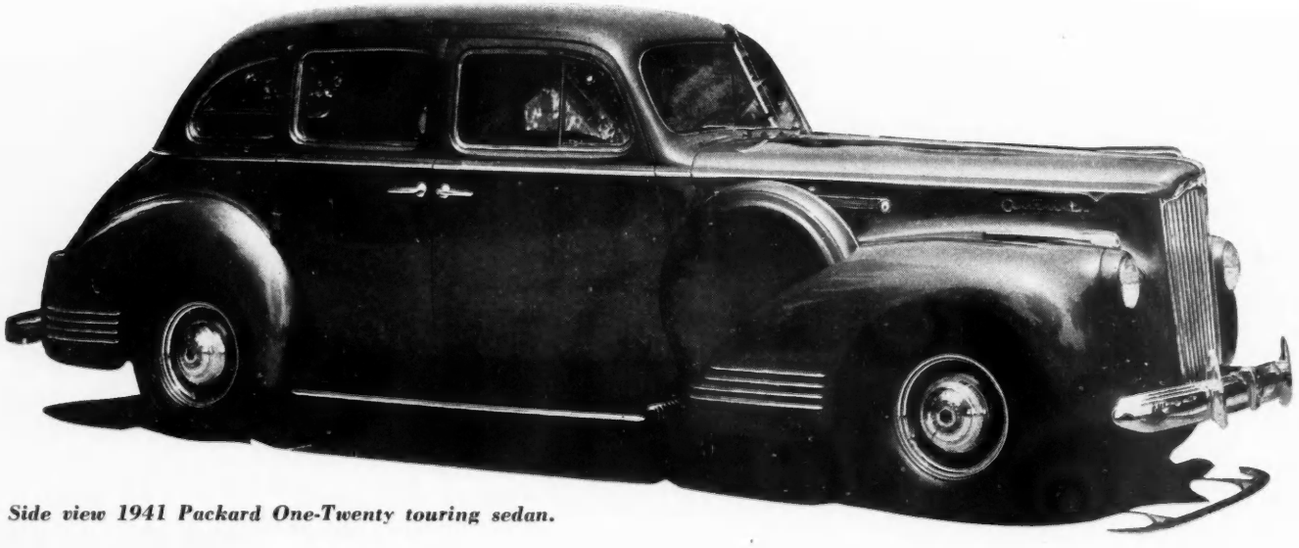
Full mechanical refrigeration, first announced last year, is now available at extra cost on every model in the line. It has been simplified by removing the heater from the rear compartment, thus providing a simple cooling installation for regions where heating is not required. For operation in colder regions, the car can be fitted with the now conventional under-seat heater or the less-expensive dash-mounted heater.

Power-operated windows are a feature of the Custom 180 models, with power operation for the partition in limousines. Power is supplied by a self-contained power unit under the seat, consisting of a reversible starting motor coupled to a pump with a tank. Each of the windows is fitted with a hydraulic cylinder which raises or lowers the window at the touch of a switch fitted on each door panel. The cylinders are solenoid-controlled, and a system of electric interlocks prevents simultaneous energization of the solenoids controlling the up and down movements respectively. The column-mounted shift mechanism is now enclosed within the steering-column housing and is fitted with an over-center-type servo spring which reduces the effort required to make the shift. Two-speed electric windshield wipers are now installed.

Engines remain practically unchanged. Series 110 is a six-cylinder L-head design of 3½-in. bore and 4¼-in. stroke (245 cu. in. displacement) rated 100 hp. at 3200 r.p.m. with the standard compression ratio of 6.39. An optional ratio of 6.71 is available.

Series 120 is an L-head straight eight of 3¼-in. bore and 4¼-in. stroke (282 cu. in. displacement), rated 120 hp. at 3600 r.p.m., with the standard compression ratio

Packard



Side view 1941 Packard One-Twenty touring sedan.

of 6.41. The optional compression ratio is 6.85.

Series 160 engine (which is also used on the 180 chassis) is an L-head straight eight of 3½-in. bore by 4⅝-in. stroke (356 cu. in. displacement), rated 160 hp. at 3600 r.p.m. with the standard compression ratio of 6.45, the optional ratio being 6.85 on 110 and 120.

Notable engine changes include the following: New engine mountings on the 160 and 180, a more accessible oil gage, new connecting-rod bearings made by AC, featuring a new high-lead-babbitt surface bonded to a porous matrix on a steel back, new exhaust valves of austenitic steel, vacuum spark advance on all models, Carter and Stromberg carburetors on the 110 and 120, a low-pressure cooling system, with 4½-lb. pressure on the 110 and 7½ lb. on the Super models. In addition, the Super models are fitted with oil-bath air cleaners. Wilcox-Rich hydraulic valve lifters are continued on the Super-Eight engine, the improved steel body being used. Spark plugs are 10-mm. on all engines. On the Super Eight there is an oil slinger as well as an oil seal at the rear main bearing.

To make it possible to lower car floors without the use of a tunnel, the front suspension has been lowered by suitably changing the wheel-carrier forging. Steering gear and pitman arms now are

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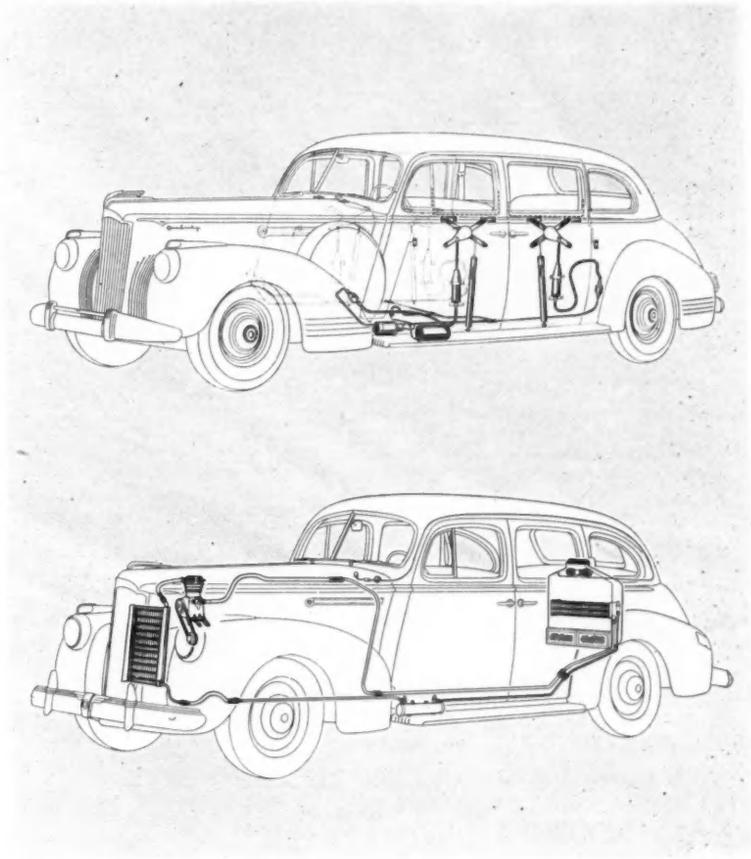
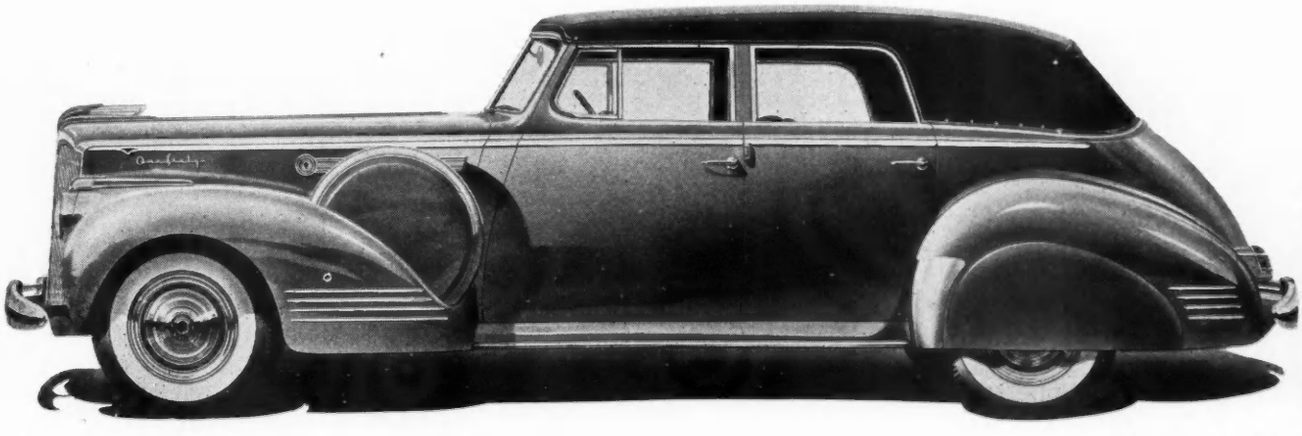


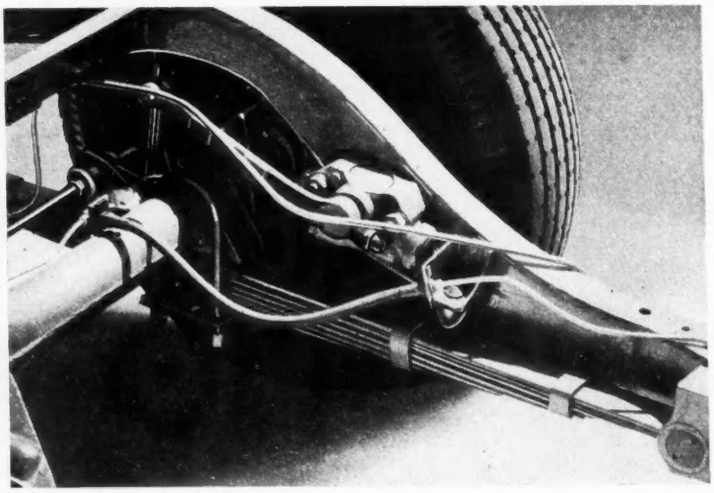
Top—Diagram of mechanical detail of automatic hydraulic window lift in 1941 Packard

Above—Diagram of 1941 Packard air-conditioning system

announces '41 models with two-tone color combinations with contrasting trim

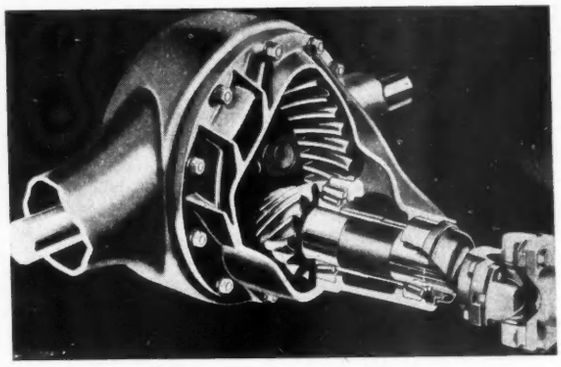
Below—1941 Packard One-Sixty convertible sedan.





The "Economy Axle" shown at the right has a gear ratio of 3.36 to 1. The standard axle ratio is 3.77 to 1.

The view at the left shows the snubber in the frame above the rear springs to prevent jolts from bottoming.



Cadillac

THE NEW-MODEL season brings an important change in Cadillac policy, as hereafter all cars turned out by the organization will bear the Cadillac name. The LaSalle "companion line" has been discontinued. All Cadillac 1941 models will have the same front-end styling, distinctive exterior treatment, and richly-appointed, Fleetwood-tailored interiors.

Among the major changes are the following:

1. Discontinuance of the Cadillac 16 and LaSalle lines.

2. Introduction of a new seven-passenger, moderate-priced car, the Series 67, to replace the Series 72 launched last year.

3. Addition of the Series 41-61 and Series 41-63.

4. Standardization of a single engine model—the 150-hp. V-8—for all models.

Series 41-61, 41-62, 41-63 and 41-60S all have a chassis of 126-in. wheelbase. The new Series 67—which has unusually low lines for a vehicle of this type—has a wheelbase of 139 in., while the wheelbase of the Series 75 Cadillac Fleetwood is 136 in.

While the engine remains basically the same, it incorporates a number of important improvements, including new Wilcox-Rich hydraulic valve lifters with steel bodies, alloy-cast-iron camshafts, new exhaust valves, a more-smoothly-operating clutch, and "Bearingized" piston-pin holes in the pistons. The compression ratio has been raised to 7.25, and the use of premium fuel is recommended.

The engine is a 90-deg. V-8 of 3½-in. bore by 4½-in. stroke (346-cu. in. displacement) developing 150 hp. at 3400 r.p.m., with a cast-iron head and 7.25 compression ratio.

Lynite and Bohn low-expansion aluminum-alloy pistons with T-slot and anodized finish are employed. In the improved hydraulic valve lifter, the lifter unit, formerly of cast iron, is now made of a case-hardening steel which is more wear-resistant and prevents galling. Relocation of the oil-bleeder hole in the body retains a greater volume of oil in the reservoir when the engine is at rest. This reduces the ratio of air to oil in the unit and improves its effectiveness as a valve silencer when the engine is first started.

The sprocket and timing chain have been redesigned for increased sprocket-tooth durability, and an alloy-cast-iron camshaft replaces the former forged shaft. The new camshaft is said to eliminate scoring and pitting of cam surfaces. A special material, said to be highly score-resistant at high temperatures, has been developed for the exhaust-valve stems. Exhaust-valve heads are of austenitic steel, the same as in 1940. Intake valves continue to be made of chrome-nickel steel.

Both Carter and Stromberg carburetors are used on the new Cadillacs. The Carter carburetor is continued with minor calibration changes, while the Stromberg carburetor has a new throttle body.

The Torbend disc clutch, introduced in 1940, is continued for 1941 with refinements. Three needle bearings replace the pin-and-socket bearings formerly used at the clutch-release lever, and provide practically frictionless operation. Annoying squeaks have been eliminated by the provision of anti-friction washers on the driving side of the clutch release levers. To insure long life of the clutch-throwout bearing, special care was taken to so arrange the design that this bearing will not rotate when the car is in motion and the clutch engaged.

Series 61, 62, 63 and 60S use a four-blade fan with detail refinements. A new five-blade fan with a strong-

ly reinforced spider is used on Series 67 and 75. Accessibility of the engine compartment has been improved by the use of a huge alligator-hood top panel, with integral side panels.

Most of the chassis changes were made with the object of improving the riding qualities. Frames are said to be 40 per cent more rigid, due to the use of box sections at the front as well as at the rear, back of the X-member. Increased stability results from increased width at the rear and an increase in the rear tread in Series 61, 62, 63, and 60S.

The recirculating-ball-type steering gear, which was introduced on the Series 72 last year, is now used on all models. Steering angles have been increased so that all cars have a shorter turning radius.

At the rear end, the Hotchkiss suspension with permanently-lubricated rear springs is continued with minor changes. Spring action has been improved by the use of an auxiliary rubber rear bumper, mounted on the frame, which not only prevents bottoming but changes the spring rate under severe deflection.

The axle ratio is 3.77 on Series 61, 62, 63, and 60S, and 4.27 on Series 67 and 75, which latter two have a new axle. On Series 61, 62, 63 and 60S "Economy" axles are optional at no extra cost. The ratio is 3.55.

The propeller shaft has been redesigned, and the splined joint is now inside the transmission extension. The sliding member has been removed from the propeller-shaft assembly and located within the transmission housing, to slip on splines on the rear of the transmission main shaft. The ball bearing on the main shaft has been replaced by two steel-backed babbitt bushings pressed into the housing, which also holds the oil seal. These bushings and the sliding member are lubricated by transmission oil.

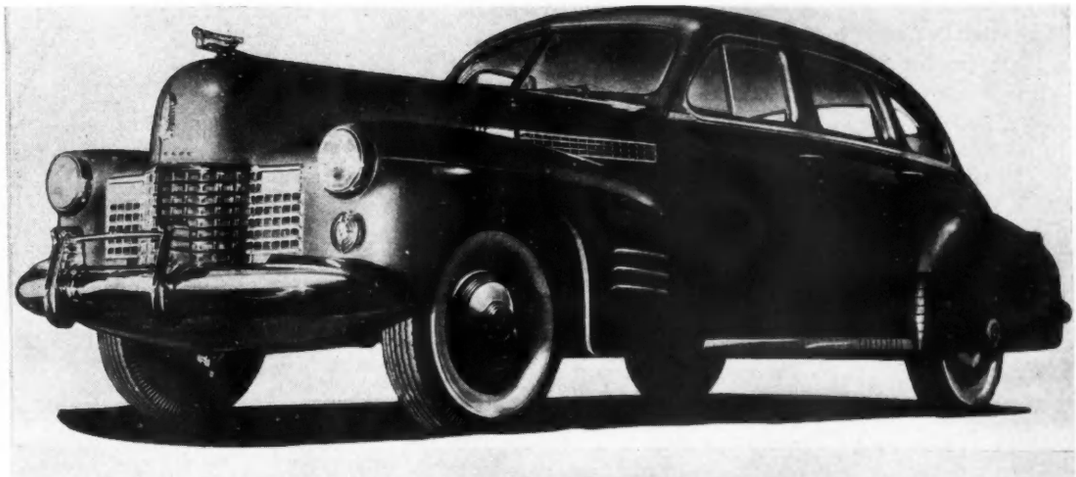
Coil-spring "knee action," with the torsion rod front-ride stabilizer, is continued on all series. On Series 61, 62, 63 and 60S the front-wheel bearings and steering knuckles are larger and much stronger. For better maintenance of correct camber adjustment, the threaded pin in the upper end of the steering-knuckle support has been replaced by a plain eccentric pin. With the new design, the camber-adjustment range has been doubled.

Slotted-disc steel wheels are used on all series. The new tire size on Series 61, 62, 63 and 60S is 7.00 x 15, four-ply. Series 67 and 75 carry 7.50 x 16, six-ply tires.

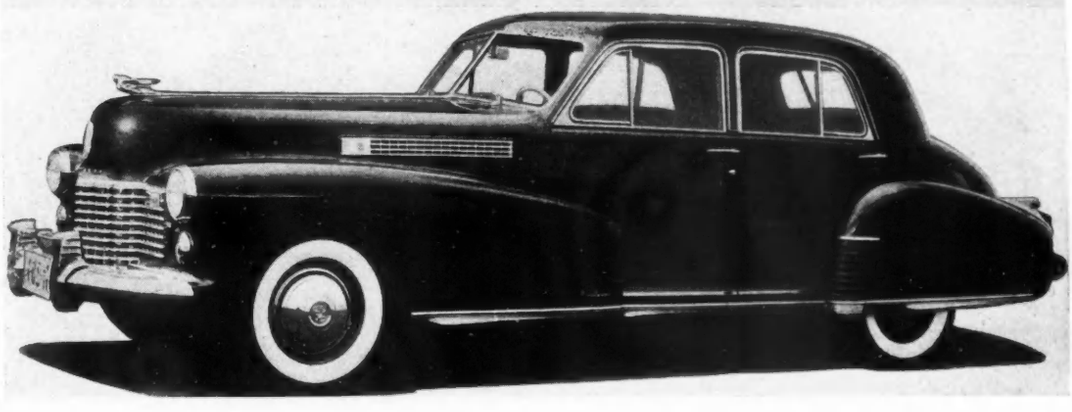
Cadillac this year have a characteristic styling

(*Turn to page* 319, *please*)

enters 1941 season with interior and exterior treatment in a new mode

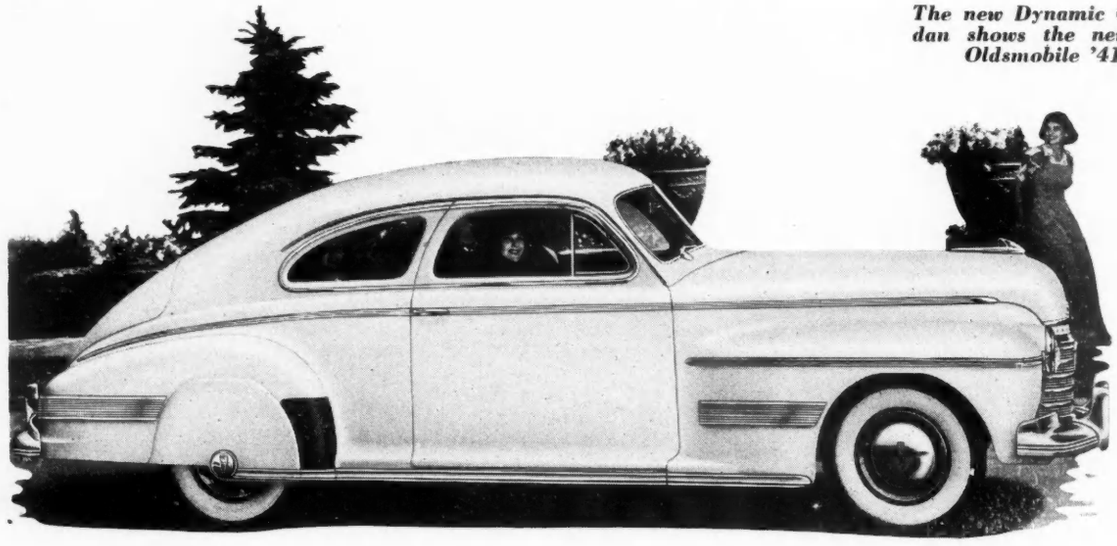


Directional signals are built into the grille of the Sixty-three Series.



The Series Sixty Special is designed for increased comfort and more flexible control.

NEW CARS



The new Dynamic Cruiser club sedan shows the new lines of the Oldsmobile '41 offerings.

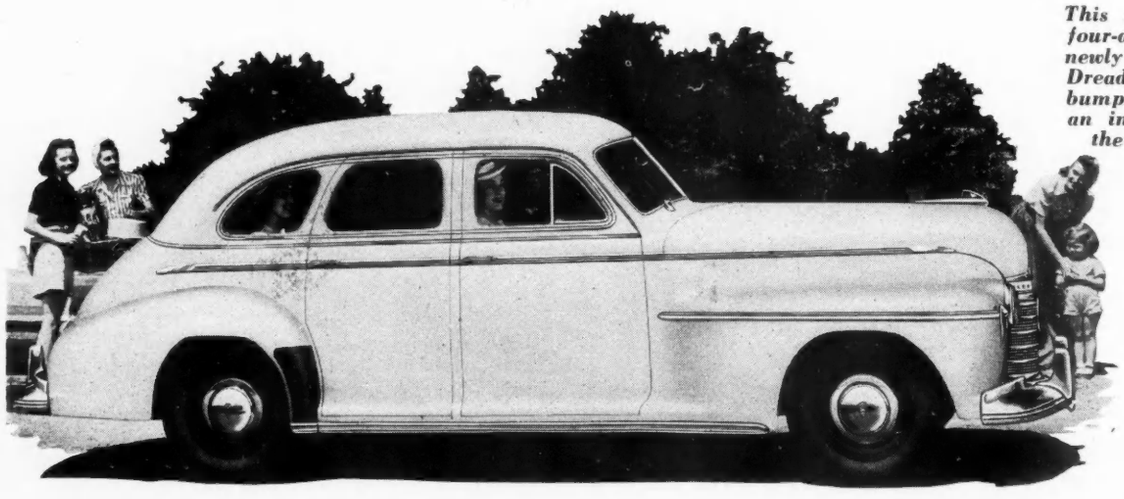
Oldsmobile

SIX and eight-cylinder engines are interchangeable in all of the three basic Oldsmobile chassis for 1941, so that the firm is, in effect, offering six different series. The line comprises the following: Oldsmobile Special with 119-in. wheelbase, known as the Series 66 when fitted with the six-cylinder and as the Series 68 when fitted with the eight-cylinder engine. Oldsmobile Dynamic Cruiser, known as Series 76 with six-cylinder and as Series 78 with eight-cylinder engine; and the Oldsmobile Custom Cruiser, known as the Series 96 with six-cylinder and as the Series 98 with eight-cylinder engine. Both the Dynamic and Custom Dynamic models have a wheelbase of 125 in., 1 in. more than last year. The wheelbase of the Special Series is up 3 in. from last year, the rear axle having been shifted back that much to accommodate the new bodies.

The Special Series now has a new streamlined body with three side windows and with built-in running boards which are exposed only when the doors are opened. The wheelbase was increased on this model in order to lower the floor level and rear seat, which is now well ahead of the rear axle. The Dynamic Cruiser Series also has a new line of streamlined bodies with built-in running boards. A feature of these bodies is a special rear panel treatment in which the profile is carried in one bold sweep from the front end right down to the tail. Bodies of the Custom Cruiser Series remain the same as last year and are without running boards.

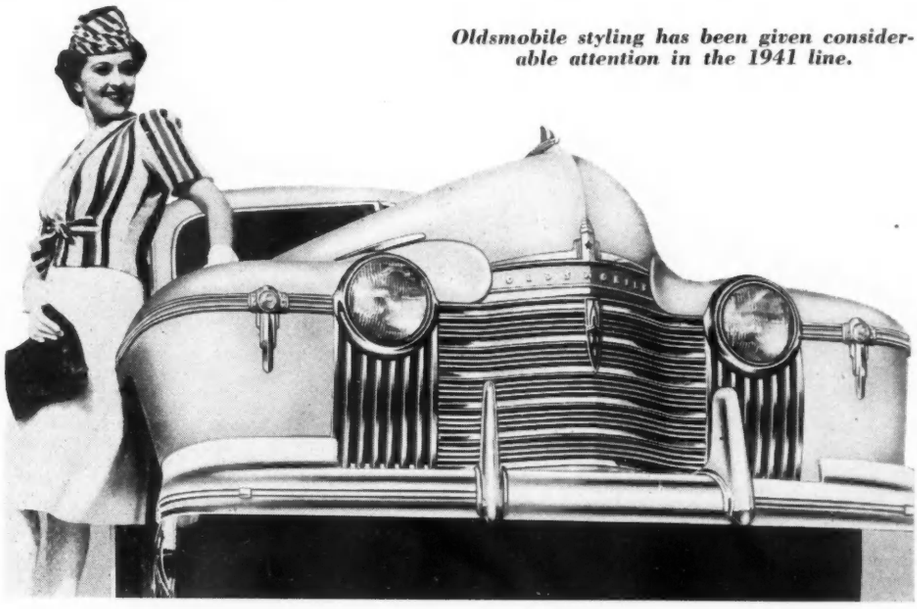
The Hydra-Matic, fully automatic transmission, with direct fourth gear, is continued without change and will be available as special equipment at extra cost on all models. As before, when the Hydra-Matic transmission is specified, the conventional mechanical clutch and clutch pedal are eliminated. In addition, rear-axle ratios of 3.42 and 3.63 are supplied in place of the standard ratios of 4.1 and 4.3.

Two engines power the Olds line this year, the Six and the Eight, both changed in details only. However,



This special series four-door sedan is newly fashioned with Dreadnaught type bumpers which form an integral part of the body design.

offers three chassis for 1941 with interchangeable six and eight engines



Oldsmobile styling has been given considerable attention in the 1941 line.

the Six has a 1/16-in. larger bore and a heavier crankshaft.

The Six is an L-head of 3½-in. bore by 4⅛-in. stroke (238-cu. in. displacement), rated 100 hp. at 3300 rpm., with a compression ratio of 6.2 and cast-iron head.

The Eight also is an L-head of 3¼-in. bore by 3⅞-in. stroke (257 cu.in. displacement), rated 110 hp. at 3500 rpm., with a compression ratio of 6.3 and cast-iron head.

Among the many new features in engines are the following: An underslung exhaust manifold, a standard fuel pump body without elbow on the Eight, improved heat insulation for the carburetor by thick gaskets on the manifold flange and between the two sections of the carburetor body on the Eight, by one thick gasket on the manifold flange on the Six.

A new one-piece hood which when lifted completely uncovers the engine compartment. All throttle-control mechanism and means for adjusting the linkage are grouped in one cluster on the engine. This is particularly helpful in the case of Hydra-Matic installations. In the case of Hydra-Matic installations, a mechanical linkage automatically throws the transmission into neutral, when stepping on the starter. This is accomplished by means of a bell-crank connecting the starter linkage to the gear-shift linkage.

To make the two engines interchangeable and still be able to use the same transmission mounts, the rear-end mounting of the engine is fixed as to location. With the Six, the front mount is back of the wide cross-member, with the radiator core mounted on the inner edge of the support member. With the Eight, the front mount is bolted to the front edge of the cross-member, while the core is fixed to the outer edge of the support member.

Transmission, clutch and rear axle remain the same as before. The radiator core is thicker than last year's to provide additional cooling capacity.

Detail changes have been made in the rear suspension system. Shock absorbers now are of the parallel-piston type; they are mounted back of the axle, and attached to the brake backing plate. This has necessitated a change in the rear stabilizer mounting, which now is ahead of the axle.

The rear tread has been increased to 61½ in., and the two stabilizer radius rods are placed somewhat farther apart at the front end. Fuel tanks are shorter, and nearly square in the plan view, to allow clearance for the vertical tire mounting in the trunk compartment. The cacapity of the fuel tank has been increased to 19½ gal.

Because of the increased vehicle weight the brakes have been increased in size. On the 66 and 68, they are now 11 x 1¾ in.; on the others, 11 x 2 in. The tire equipment is as follows: On the 66, 16 x 6.00; on the 68, 76 and 78, 16 x 6.50; on the 96 and 98, 15 x 7.00. To provide maximum stability, Olds is using the largest sized rims approved by the tire producers. For the 6.00-in. tire, the rim is 4.50 in.; for the 6.50, 5.00 in.; for the 7.00, 5.50 in.

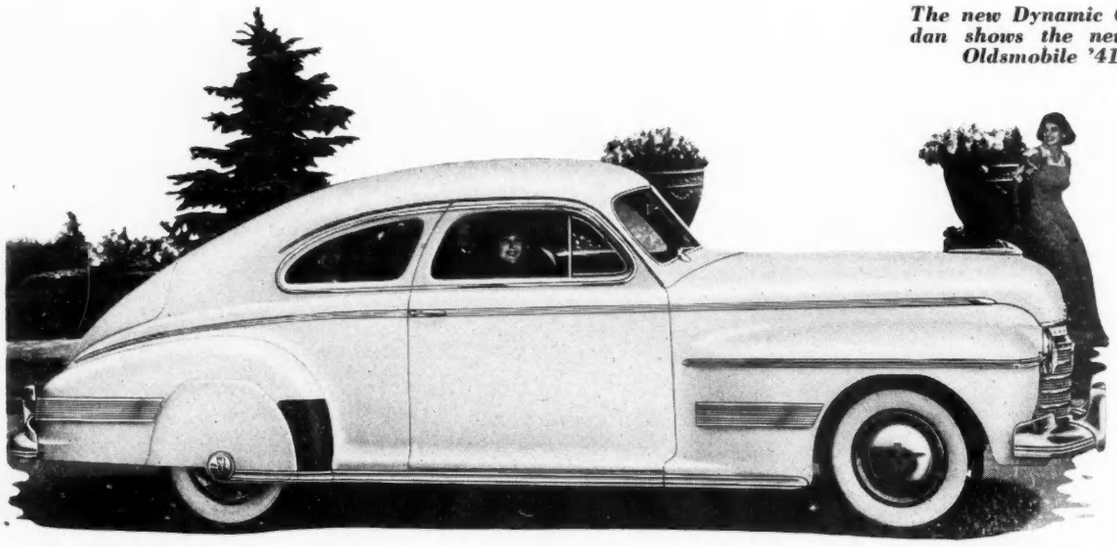
Styling is uniform throughout the line. New and massive die-cast grilles are complemented by larger side grilles which take in most of the cooling air. Bumpers, front and rear, are new and massive, and add to the eye-appeal of the front end.

Front fenders are larger, with straight-faced shoulders at the front to accommodate the inset headlamps and parking-lamp lenses. The Custom (deluxe) jobs have the chrome grilles on front and rear fender skirts, in addition to the chrome moldings found throughout. All models have the gas tank filler spout inside the fender, accessible through a hinged door.

On the Special Series, the front fender line is carried right to the door, a portion of the skirting being made a part of the front edge of the front doors. Front fenders on all models are turned up at the front end to produce the integral gravel shield.

Instrument panel treatment is the same for all models, except for deluxe treatment which includes a Lucite face for the instrument cluster, and a Lucite panel for the large clock mounting on the right-hand panel. The instrument panel is set off handsomely by

(*Turn to page* 416, *please*)



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(*Turn to page* 416, *please*)

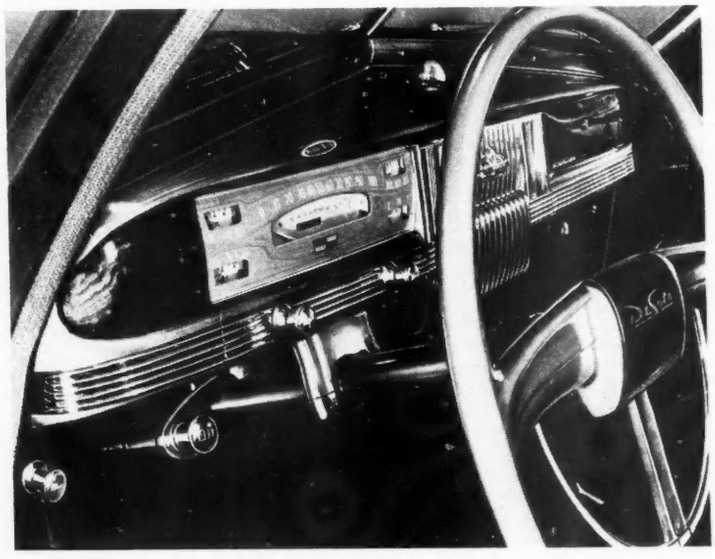
De Soto

DE SOTO continues its Deluxe and Custom models for 1941 with various improvements in chassis and body. Added to the Custom line this year are a four-door, four-window town sedan with rear doors opening forward; a brougham with flipper windows for rear-seat ventilation, and a club coupe with a 55-in. single-cushion rear seat and 4-in. increase in knee room. Other custom types are the four-door, six-window sedan, a seven-passenger sedan, limousine, business coupe, and convertible club coupe. The Deluxe line comprises a four-door sedan, two-door sedan, seven-passenger sedan, a coupe, and a club coupe.

The 1941 De Soto has a wheelbase of 121½ in., 1 in. less than last year, but its overall length has been increased 5½ in., to 207¾ in., and the overall width 2¼ in., to 66⅝ in., while the height has been reduced 1½ in. without sacrifice in head room. Seven-passenger sedans and limousines have a wheelbase of 139½ in.

The new bodies, referred to as Rocket bodies, are longer, lower and wider. The distance from the engine bulkhead to the rear of the body is 4½ in. greater, and the window area has been increased by 47.5 per cent. Other features of the new bodies include chrome belt moldings and fender speed lines, flipper windows for rear-seat ventilation, an alligator-type hood with lock control inside the driver's compartment, a concealed luggage locker with counterbalanced lid, wider door entrances, a hold-open device on front doors, and a flatter windshield. The general appearance of the car has been considerably changed, as clearly shown by the photographs reproduced herewith.

In the Custom models the upholstery, instrument panel and interior hardware are given a two-tone treatment, the two-tone effect in the hardware being obtained by the use of tenite inserts that match the darker upholstery color. Center arm rests are standard equipment in the Custom brougham and town sedan, while all four-door sedans have deeply-recessed rear-seat arm rests extending into the body shell.



Instrument panel and steering wheel are of new design.

New front of the '41 De Soto shows separate parking lights, new type grille and fenders with a flat top.

...has new line of longer, lower and wider bodies for 1941

The steering wheel is of new design, with a single horizontal spoke which leaves the entire upper portion free for a clear view of the instruments. In the lower portion there is a chrome-finish half ring for horn operation. It is located within finger-length of the wheel rim, which latter has molded finger grips at the "4 o'clock" and "8 o'clock" positions. The speedometer has large numerals and its needle glows red when indicating speeds in excess of 50 m.p.h.

There are few changes in the six-cylinder DeSoto engine, of 3⅜-in. bore and 4¼-in. stroke (228 cu. in. displacement) which is rated 105 hp. at 3600 r.p.m., but it is fitted with a new type of more endurable bearings and equipped with an oil-bath-type air cleaner. The storage battery is now located in the engine compartment in the left-fender shield, for greater convenience in servicing.

Standard equipment on the DeSoto this year is a three-speed transmission, the same as in previous years, but the second-speed ratio has been increased to 1.83, to make is possible to get good acceleration when starting in second gear. Other ratios in the transmission, as well as the rear-axle ratio (4.1) remain the same. Available for use with this transmission is a vacuum-power shifter.

As optional equipment, DeSoto offers a drive unit comprising the fluid coupling, conventional clutch, and a special semi-automatic four-speed transmission, providing excellent performance characteristics. With this combination, overdrive is eliminated, since direct in fourth provides a gear reduction of 3.54 (axle reduction) which is close enough to overdrive to effect a good compromise.

In effect, the transmission provides two sets of gear ranges—a high and a low range—selected by manual control, using the conventional clutch pedal for the shift. However, the shift within each range—from third to high, or from first to second—is accomplished simply by removing the foot from the accelerator pedal. At this point, the shift is made automatically

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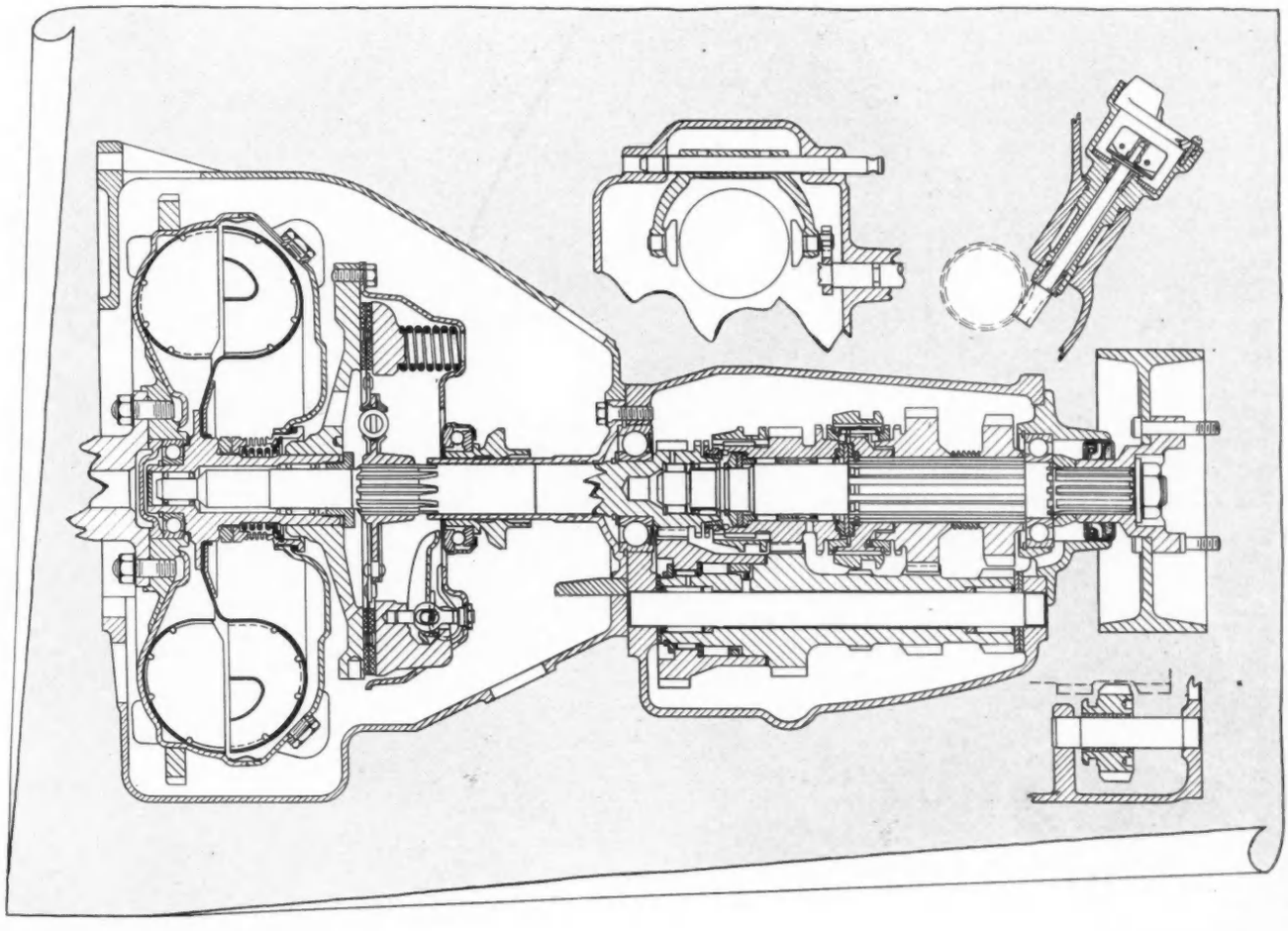
Details of the fluid-drive four-speed, semi-automatic transmission offered in '41 De Soto as an optional feature.



Nash *brings out its new 600 line to bid for sales in the low price field*

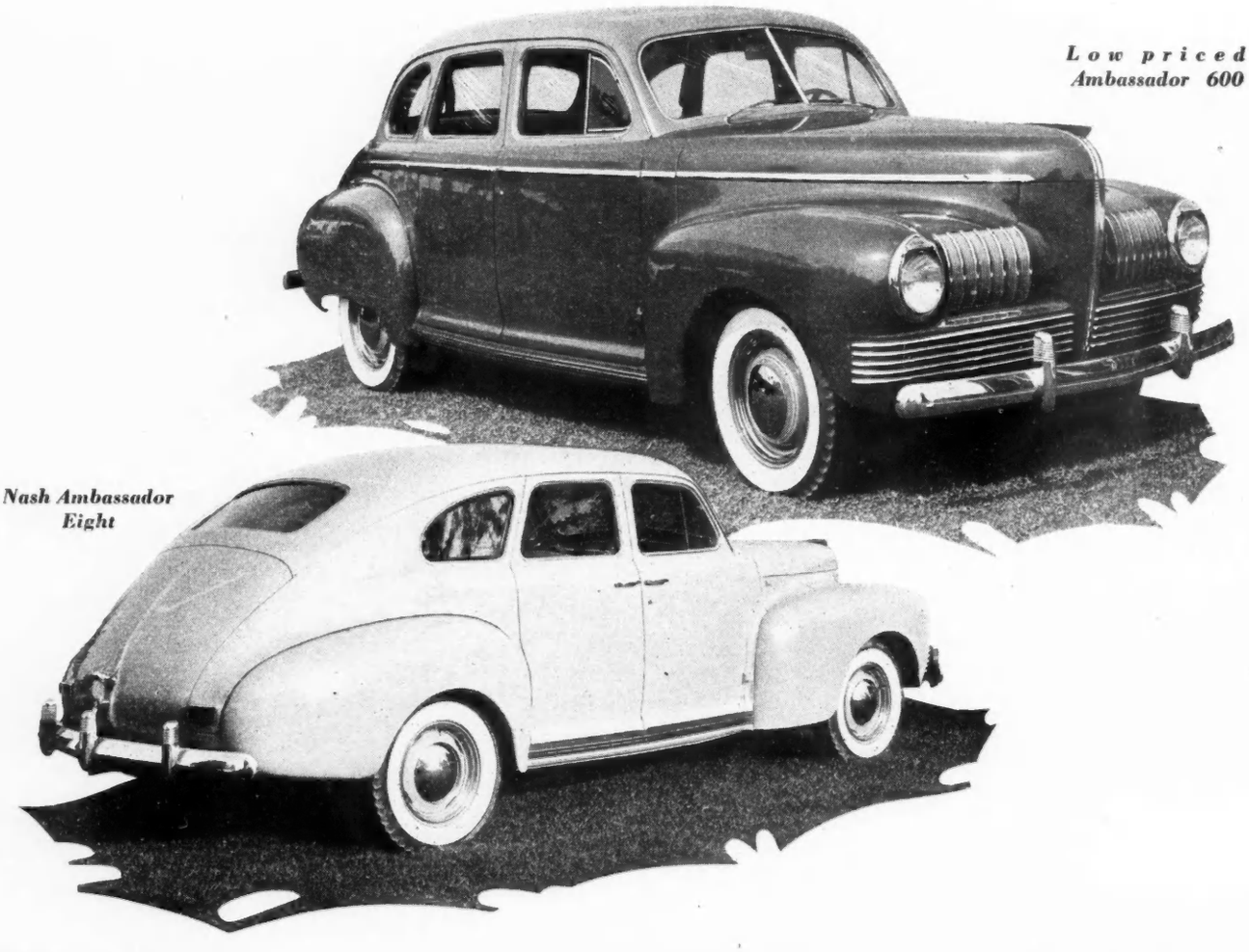
NASH this year appears on the market with a new model, the Ambassador 600, which is intended to place the firm definitely in the low-priced field. The most interesting mechanical features of the new car are that it is of unit construction, the frame being integral with the body, and that it has independent suspension in front and coil-spring suspension all around. A strong point is made with respect to economy of operation, a fuel mileage of 25-30 per gallon being claimed. This new low-priced Ambassador 600 will be accompanied by Ambassador Eights and Sixes, the three lines together comprising 15 models.

The Ambassador 600 is equipped with a six-cylinder L-head engine of 3⅛-in. bore by 3¾-in. stroke (172.6 cu. in. displacement) which is rated 75 hp. at 3600 r.p.m., with a compression ratio of 6.7. Water jackets extend all the way down the cylinders. Pistons are of the steel-strut aluminum type. A downdraft carburetor is fitted. Lubrication is by the pressure system, connecting rods being rifle-drilled. The crankshaft-and-flywheel assembly is dynamically balanced.

The body carried by the new Ambassador 600, which is built in the Nash body plant in Milwaukee, is an all-steel welded unit with integral chassis frame and bridge-truss construction. It is claimed that by adopting this form of construction, between 400 and 500 lb. of weight was saved. The body is said to be quite roomy and in the case of sedans, to accommodate six persons comfortably. Glass area in both the windshield and the curved rear window has been increased over 1940.

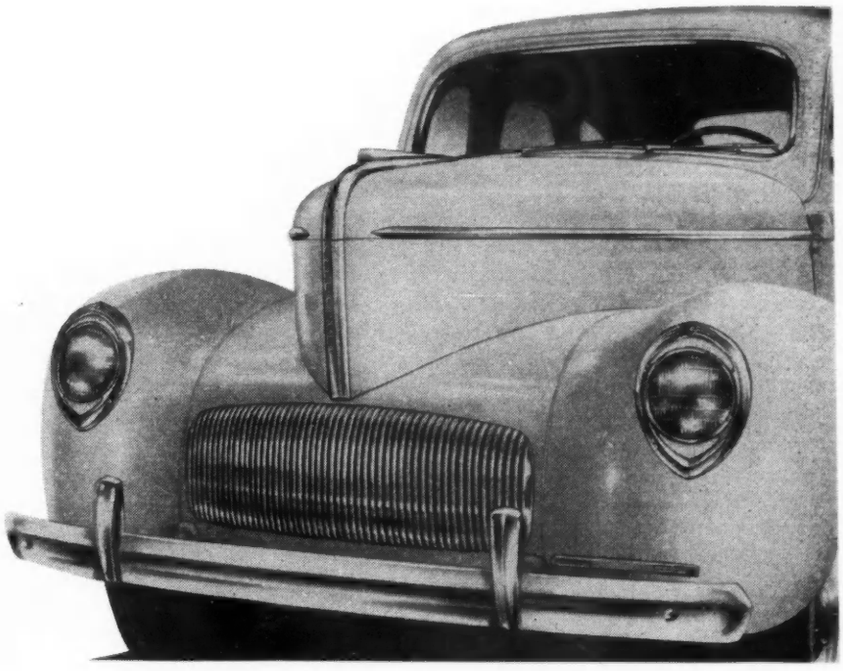
Concealed running boards are a feature of the Ambassador 600 bodies. When the doors are closed the only indication of running boards are the covered crash bars. The running boards are flush with the floors and are covered with ribbed rubber for safety. Bodies are insulated and sound-proofed with "Sand Mortex." Doors are double "weather-sealed," and the body and fenders are bonderized to prevent rust. These parts

(*Turn to page* 402, *please*)



Low priced Ambassador 600

Nash Ambassador Eight



The Willys-Americar offers new lines for '41 with a more massive front treatment and Gothic style belt moldings.

Willys

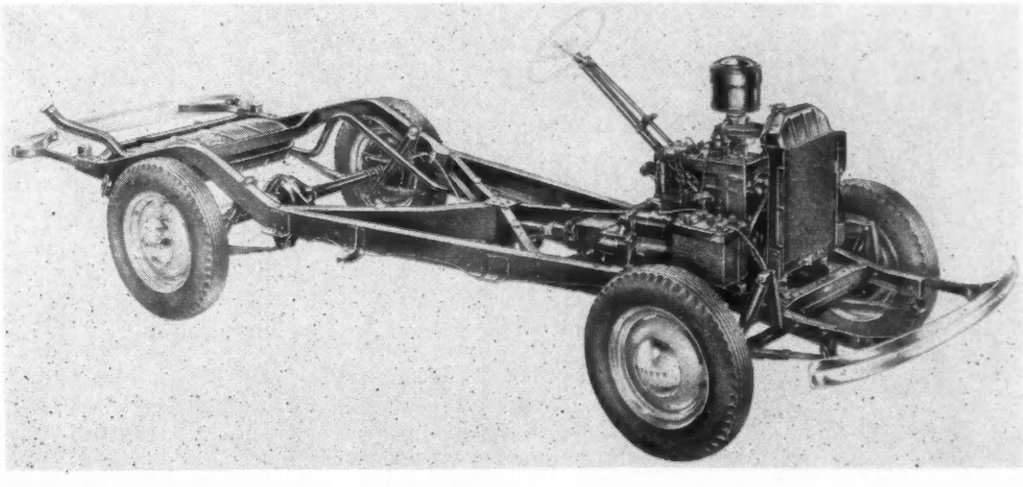
offering for 1941 is termed the Americar. It is designed for improved operation and riding comfort

THERE have been no fundamental changes in the design of the car produced by the Willys organization, which will be marketed under the trade name Willys-Americar this year, but mechanical details have been subjected to a searching revision, and bodies have been redesigned with a view to better weight and space distribution and additional eye appeal.

Although the wheelbase has been lengthened 2 in., to 104 in., the overall length remains the same, and the weight has been only slightly increased. Advantage has been taken of the increase in wheelbase to increase the legroom, and at the same time the headroom and the width of the rear seat have been added to. The new bodies, restricted to two types, a sedan and a coupe, are tastefully streamlined. Two-tone paint combinations are offered, with harmonizing or contrasting trim options. Headlamps are of the same type as last year, that is, safety headlamps of weather-proof construction set into the front fenders.

Apart from improving the styling, the engineering effort has been directed chiefly toward greater riding comfort, improved performance, and higher fuel economy. Engineering Department road tests are said to have shown the following average economy figures:

(*Turn to page* 420, *please*)



The chassis of the Willys-Americar has a more rigid frame, a new hypoid rear axle, and column-mounted gearshift which is standard equipment.

Chevrolet

FOR 1941, the Chevrolet passenger car line will consist of two series, the Special Deluxe and the Master Deluxe. The Master 85 series is omitted. Body styles in both series remain as in 1940, those in the Special Deluxe including a sport sedan, town sedan, five-passenger coupe, business coupe, cabriolet and station wagon, and those in the Master Deluxe line the sport sedan, town sedan, five-passenger coupe, business coupe, coupe pickup and sedan delivery. Both chassis will have the same knee-action suspension.

With an increase of 3 in. in the wheelbase, to 116 in., the new cars are longer, wider, and lower, yet the ground clearance at critical points has not been affected. An increase in the rear tread from 59 to 60 in. has improved the stability.

Styling is completely new, with larger and more massive front and rear fenders, a larger and deeper hood. Front-end appearance is enhanced by a new die-cast radiator grille, more massive front bumpers, and a centrally-mounted license-plate holder.

Bodies are entirely new. Concealed running boards are exposed upon opening the door. There is a front-door lock on each side. Concealed hinges now are used on all doors and on the trunk lid. The width at the floor inside the body pillars was increased an average of 5 in., while the width at the roof is just about the same as in 1940. Front-seat width, as measured from door to door on the cushion, was increased more than 3 in., from 54⅜ to 57½ in. The rear-seat cushion has been widened from 47½ to 48½ in. between arm rests.

Although the principal dimensions of the engine remain unchanged, its rating has been increased to 90 hp. It is a six-cylinder valve-in-head engine of 3½-in. bore by 3¾-in. stroke (216.5-cu. in. displacement) with a compression ratio of 6.5 (up from 6.25). The increase in power output has been achieved by redesigning the combustion chamber and piston, lowering the roof around the intake valve, and making the top of the piston flat instead of dome-shaped. Ten-mm. spark plugs now are standard equipment.

A new coil and condenser have greater capacity, and a reversing switch has been added to the ignition system. The reversing switch, which is mounted on top of the starter, is actuated each time the starting motor starts the engine. Its purpose is to reverse the direction of current flow through the breaker. When current flows between the points of a breaker separated from each other, there is a transfer of tungsten from one to the other, depending on the direction of current flow. By periodically reversing the direction of current flow, the direction of this transfer is changed, the contact points are kept in better condition, and their life is prolonged. The ranges of spark advance by the speed-sensitive governor and the vacuum chamber have been increased, that by the vacuum chamber from 17 to 20 deg., in the interest of higher fuel economy.

Improvements in the cooling system include a larger radiator core, better cooling of exhaust valves and seats, extended water-jacket passages in the head, and a new double-outlet water pump.

The Carter carburetor has been redesigned to increase engine output and economy. It now has a throttle bore of a full 1½ in. The orifice in the idle tube is now placed lower therein, to prevent engine stalling when making a very quick stop, and it is located vertically in the tube to reduce the chances of dirt obstructing the opening. The passage from the float chamber to the air horn has been made more direct, to permit a freer escape of gasoline vapor from the float chamber and incidentally to simplify production operations. The air-horn end of this passage now termi-

Driver's compartment of the 1941 Chevrolet.

This view of the new Chevrolet brings out the changes in styling.

offerings consist of two lines with mechanical improvements and complete restyling

nates in a tube that is located on the atmospheric side of the choke valve. This eliminates the hole in the choke-valve shaft that was used in 1940 to allow air to enter the balance passage when the choke was closed. The choke valve is now an angle valve, which eliminates the retractor spring on the operating lever. The unobstructed passage for vapors from the float chamber also permits of the use of a metal cover for the hole for the metering rod, replacing the Bakelite cover.

Lubrication of valve stems and timing gears has been improved. The rocker arms now have an offset, to allow for the change in position of the valves. Their material is the newly developed ArMasteel, a semi-steel said to have unusual wear-resisting qualities. Bronze bushings have been eliminated, the arms being diamond-bored and operating directly on the shaft. After being bored they are "granodized" to prevent scoring or scuffing of the bearing surface by the hardened shaft.

Interior of the rear compartment, showing the wider seat, small control "tunnel" in floor, and doors hinged to center pillars.

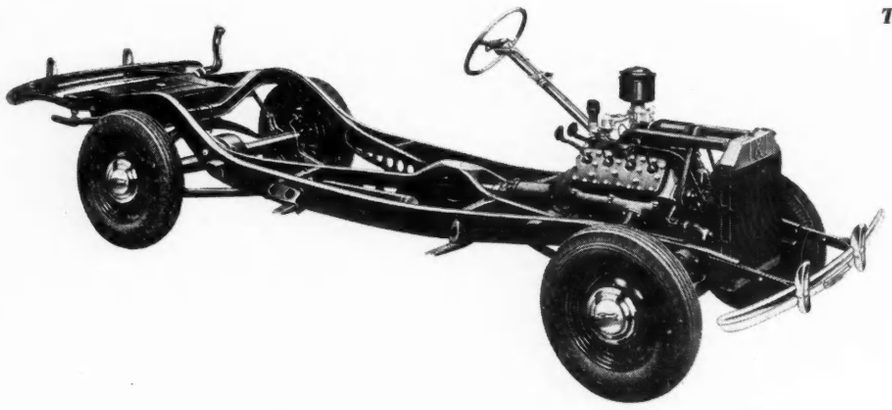
In the transmission the main shaft now has six instead of 18 splines. Lands between splines are ground for accuracy of centering the second- and third-speed clutch, the inside of which also is ground for the same purpose. This improves the fit as well as the accuracy of centering of clutch and synchronizers, which results in better synchronizer action and prevents gear disengagement by sudden acceleration or deceleration.

The flange of the clutch-gear bearing has been strengthened by thickening it. Wear resistance of the shifter yokes is increased by granodizing them.

Servicing of the universal joint or rear axle is possible without disturbing the vacuum-power cylinder,

(*Turn to page* 418, *please*)

NEW CARS



The Ford frame has been redesigned with a box-type center section.

Ford Lines

FORD MOTOR COMPANY in 1941 will offer six lines of cars covering a wide price range. They include the Ford Deluxe, Ford Super Deluxe, Mercury 8, Lincoln-Zephyr, Lincoln Continental, and Lincoln Custom.

Ford models are mounted on the same chassis, of 114-in. wheelbase, up 2 in. The Ford Deluxe is offered in four body types, the Fordor, Tudor, coupe and station wagon, and in three color options. The Super Deluxe, in addition to those body types, is available also as a convertible club coupe and as a close-coupled sedan coupe. Six color options are offered in the Super Deluxe line. A feature of the convertible club coupe is an automatic top operated by two electric motors, instead of by vacuum.

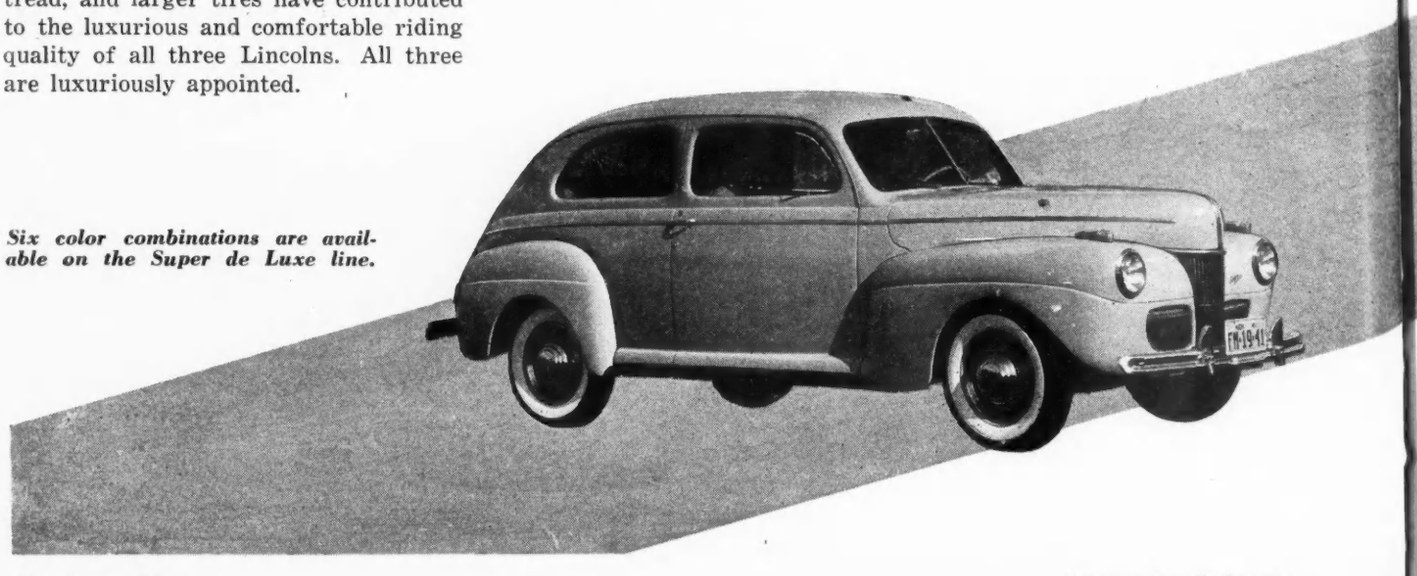
The Mercury 8 has a wheelbase of 118 in., up 2 in. It comes in six body types, viz., two-door and four-door sedans, coupe, club convertible, sedan coupe, and a new station wagon.

There are three distinct lines of Lincoln cars—the Lincoln-Zephyr, the Lincoln Continental, and the Lincoln Custom. All have unit body-and-frame construction, which provides great strength and safety with low weight. The Lincoln-Zephyr and the Lincoln Continental both have a 125-inch wheelbase, while the Lincoln Custom has a wheelbase of 138-inch. All are powered by the 120-hp., V-12 engine, in which the compression ratio has been increased to 7.00. Longer and softer springs, a wider rear tread, and larger tires have contributed to the luxurious and comfortable riding quality of all three Lincolns. All three are luxuriously appointed.

The Lincoln-Zephyr is available in four body types—sedan, coupe, club coupe and convertible coupe—and in eight optional colors. All four bodies are equipped with push-button door latches on the inside, instead of door handles, but safety handles are provided on the outside.

The Lincoln Continental cabriolet, which created a sensation at its introduction last year because of its long, low lines, appears in a still more attractive version. It is joined this year by a Continental coupe of equally-outstanding styling. Each of these models accommodates six passengers comfortably. Push-button door handles are provided both inside and outside the Lincoln Continentals.

The new Lincoln Custom features door windows which are operated by pressing buttons on the instrument panel and individually on the two rear doors. The window between the driver and passenger compartments in the limousine and the front seats in sedan models are operated in a similar manner. Interiors of the Lincoln Custom are offered in four different colors, maroon, tan, green, and blue. In each case the colors of



Six color combinations are available on the Super de Luxe line.

the floor carpet, side and seat upholstery blend in a combination set off by pale gold hardware and maroon plastic knobs.

On Lincoln cars, the following equipment is available, factory-installed at extra cost: Automatic choke, transmission overdrive unit with automatic shift, two-speed axle with manual shift.

Improved riding qualities in the Fords and the Mercure are due to new front and rear springs of lower frequency, a better balance between the action of front and rear springs, reversed-type shackles, larger front shock absorbers, and an improved ride stabilizer.

An increase of 100 per cent in the rigidity of the Ford frame was achieved by providing it with a completely redesigned and more rigidly braced X-member which has a box-type center section with a maximum depth of approximately 9 in. One reason for the great depth of this center section is that the torque tube now passes through the X-member, and adequate clearance must be provided for it.

The new X-member is an electrically-welded one-piece unit. Its center section consists of two large steel stampings, the top one having its side flanges extending downward and the bottom having its side flanges extending upward. These two stampings are flash-welded together; then the legs or channels of the X-member are each flash-welded to this center section. This method of fabrication is said to result in greater strength than the customary method of riveting center section members to the side channels of the X-member.

Basic specifications of the engines for the Ford and Mercury lines remain unchanged. The familiar V-8, 85-hp. engine is used on the Ford; the V-8, 95-hp. engine on the Mercury. In both engines, the camshaft gear is bolted to the camshaft so as to be independently replaceable, by simply removing the radiator and the gear-case cover.

Hardened valve stems are an innovation for 1941.

for the 1941 season feature several refinements and cover wide price range

Above is the Mercury 8 offered in six body types.

The Lincoln-Zephyr has unit body-and-frame construction. The wheelbase is 125 inches.

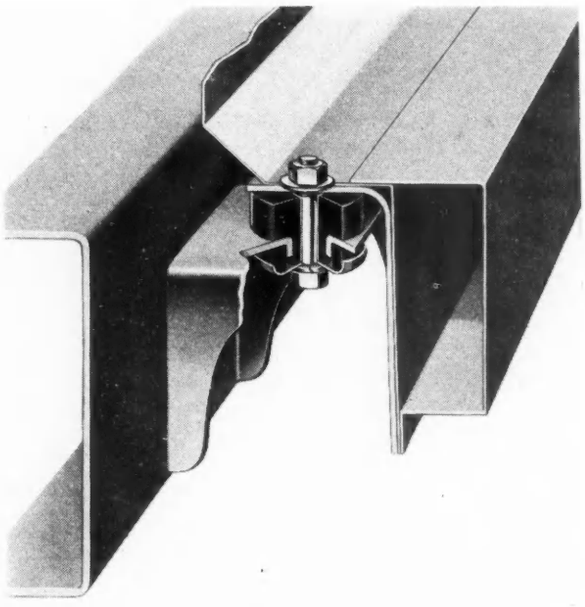
NEW CARS

The upper portion of the valve stem, which moves up and down in the valve guide, is hardened to minimize wear. The action of the vacuum-type windshield wiper has been improved by locating the vacuum connection on the carburetor riser, where the vacuum is influenced by all eight cylinders. All carburetors are now of Ford make.

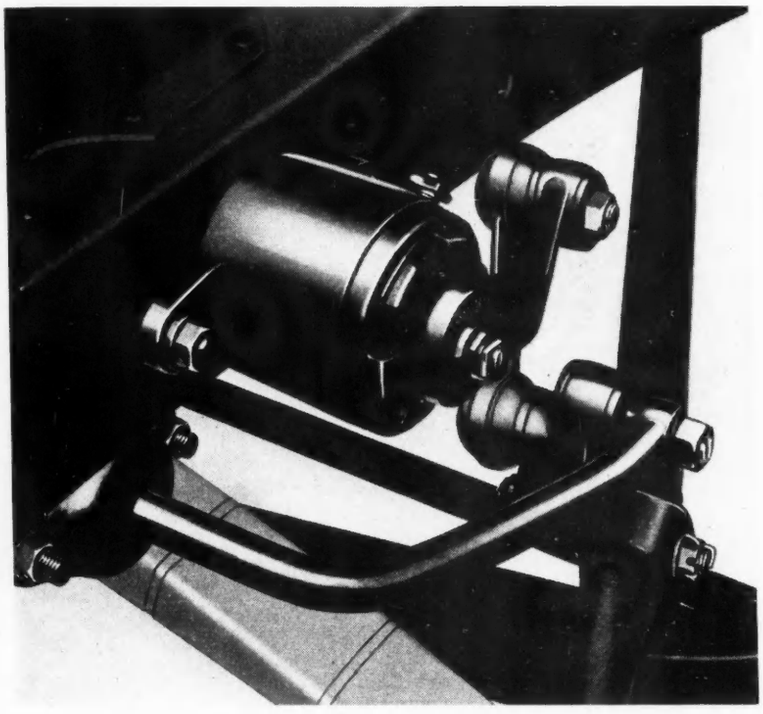
Front shock absorvers on the Ford are now larger, with 20 per cent more fluid capacity, making them the same in size as the rear shock absorbers, which are unchanged in size, but have a lower setting and consequently easier action. Both front and rear shock absorbers have a new type metering adjustment with a double tapered valve. This increases the range of the adjusting pointer for the same degree of metering-valve action.

A new stabilizer bar on both Ford and Mercury cars deserves special mention. It has swinging shackle connections instead of ends sliding in bushings. As the axle moves up and down, the shackles swing back and forth through a small arc. The back-and-forth movement of the axle is reduced because the new front radius rods are 4 in. longer. A slight reduction in the length of the stabilizer bar arms has the effect of increasing the torsional resistance of the bar, so that the stabilizing action is increased.

Connections to the front axle do not require lubrication. The top of the swinging shackle is attached to the arm of the bar by a ball and socket joint which has a steel ball working in an oil-impregnated, non-metallic socket. This ball joint is similar to the one used on the ends of the shock-absorber links. At the lower end of the swinging shackle a standard front-spring-shackle stud and bushing are used.



Schematic sectional view showing the type of body mounting used on all 1941 Ford and Mercury closed cars.



Close-up view showing end of torsion bar and arrangement of shock absorber. This constuction is incorporated in 1941 model Ford Super DeLuxe and Mercury cars.

On the Mercury the clutch diameter has been increased to 10 in. The clutch pedal pressure on Fords and the Mercury has been reduced 15 per cent by changing the position of the clutch-pedal, retracting spring so that the force with which it pulls the pedal back decreases as the pedal is pressed down. This effect is similar to that of the even-center type of retracting spring.

The 1941 Ford will have higher acceleration in first and second gears, because the gear ratios in the transmission have been increased, to 3.114 for first and 1.773 for second speed. All brake linings, both front and rear, are now of the molded type.

An improvement has been made in mounting the bodies on the frames, to prevent the transmission of road strains to the bodies. Also, the rubber insulators for the body bolts (used on all bodies except the Ford and Mercury convertibles) are twice the size previously used. There are 14 rubber-insulated body bolts altogether—six on each side and two at the rear.

New reinforcing brackets minimize twisting of the frame side members at the points where the outrigger brackets support the overhanging side of the body. The rubber insulation for the body bolts consists of two pieces. One part is a stepped cylinder with diam-

(*Turn to page* 408, *please*)

The productive capacity of a milling machine depends more upon its rigidity than on any one other factor. Rigidity originates in the column — the backbone of the machine. Examine the column of a Milwaukee Milling Machine and you will see that it has been carefully engineered for the proper distribution of metal. An inside horizontal wall divides it into a double box section; the cross mounting of the motor permits a solid rear wall, which together with the solid front face, assures an unusually rigid structure.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.

MILWAUKEE MILLING MACHINES

The 1941 New Yorker Model

Chrysler

goes into the new year with four lines distinctively styled

CHRYSLER cars are to be offered in four lines this year with a total of 26 models; they vary in size and richness of appointments to cover a wide price range. These lines are known as the Royal, Windsor, New Yorker, and Crown Imperial.

The Royal, which has an over-all length of 211 13/16 in., is equipped with a six-cylinder "Spitfire" engine rated 112 hp. with a cast-iron cylinder head and 6.8 compression ratio, and 115 hp. with an aluminum head and 7.2 compression ratio. The seven body styles offered are a four-door sedan, two-door victoria sedan, town sedan, eight-passenger sedan, eight-passenger sedan-limousine, three-passenger coupe, six-passenger club coupe, and convertible coupe.

The Windsor, built on the same chassis as the Royal, is offered in the same body styles. The difference between these two lines lies in the upholstery, trim and equipment.

The New Yorker measures 217 13/16 in. over all. It is powered by an eight-cylinder "Spitfire" engine rated 137 hp. with cast-iron head and a 6.8 compression ratio. With an aluminum head and 7.2 compression ratio it develops 140 hp. Six body styles are available, namely, four-door sedan, two-door Victoria sedan, town sedan, three-passenger coupe, six-passenger club coupe, and convertible coupe.

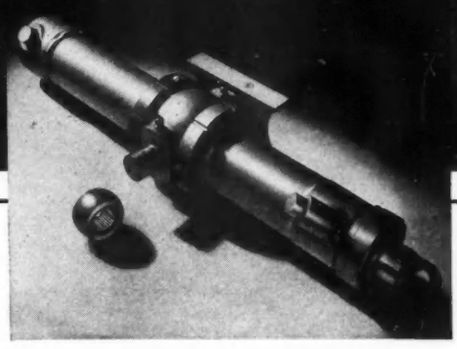
The Crown Imperial measures 231 3/16 in. over all. Its eight-cylinder "Spitfire" engine develops 143 hp. with aluminum head. Four body styles are listed, viz., a six-

(*Turn to page* 414, *please*)

These two views of the Chrysler New Yorker show the commodious front seat and the advanced styling of the hood and grilles.

24 TORRINGTON NEEDLE BEARINGS APPLICATIONS . . .

SAVE WEIGHT and INCREASE PAY LOAD ON THE NEW LOCKHEED LODESTAR



(*Above*) On engine control, rudder pedal assembly, heating system—at a score of strategic points—designers of this world-famous Lockheed Lodestar have insured smooth, dependable anti-friction operation with *minimum* weight, by using the unique Torrington Bearing.

(*Right*) Torrington Needle Bearings are used to support this hydraulic actuating cylinder which operates the retractable landing gear mechanism—one of the most severe conditions a bearing has to stand.

IN airplane design, every ounce counts. Lockheed Aircraft Corporation makes substantial weight savings, with resultant increases in pay load, by using Torrington Needle Bearings for *twenty-four* applications on its new transport, the Lockheed Lodestar.

Typical is the use of Needle Bearings on the hydraulic actuating cylinder of the retractable landing gear. Says P. A. Beck, Lockheed Specification Engineer, in referring to the high loads which these unique bearings have to support...

TORRINGTON NEEDLE BEARINGS are also used at these points on the new Lockheed Lodestar:

- Drum Assembly—Engine Control
- Trunnion Assembly—Equipment Cabin Chair Mechanism
- Trestle Assembly—Equipment—Cabin Chair
- Trestle Assembly—Equipment—Rear Cabin Chair
- End—Equipment—Heating System—Mixing Valve
- Joint—Elevator Control Universal
- Rudder Pedal Assembly Surface Controls
- Bracket Equipment Cabin Chair Mechanism
- Block—Equipment—Heating System—Butterfly Bearing
- Pulley—Engine Control Stand Fuel Valve Cable
- Tube Assembly—Surface Control Rudder Pedal Torque
- Bearing Plate—P. P. Oil Cooler Scoop

"Under normal conditions, in level flight, these loads are at least 1300 lbs. per wheel or 650 lbs. per bearing—but in rough air, loads are increased considerably—often doubling and at times tripling. The maximum design load for this condition is 8900 lbs. per wheel or 4450 lbs. per bearing. Yet in spite of this static and changeable load, *these bearings stand up* and are movable every time the landing gear is operated.

"Even then," adds Mr. Beck, "the bearings never make a complete revolution, since the total angular movement of the actuating cylinder is approximately 60°. This static load condition, together with the fact that the angular movement of the bearing is only a fraction of a revolution, combine to give *one of the most severe operating conditions a bearing has to stand!* Torrington Needle Bearings were selected for this important installation because of their line contact, light weight and small space requirement."

* * *

And, in addition, they are low in cost, easy to install and easy to lubricate. Our Engineering Department will be glad to work with *yours* in adapting the Needle Bearing to *your* special requirements. For information, send for Catalog No. 7. For Needle Bearings to be used in heavier service, consult our Engineering Department for special bearing designs.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
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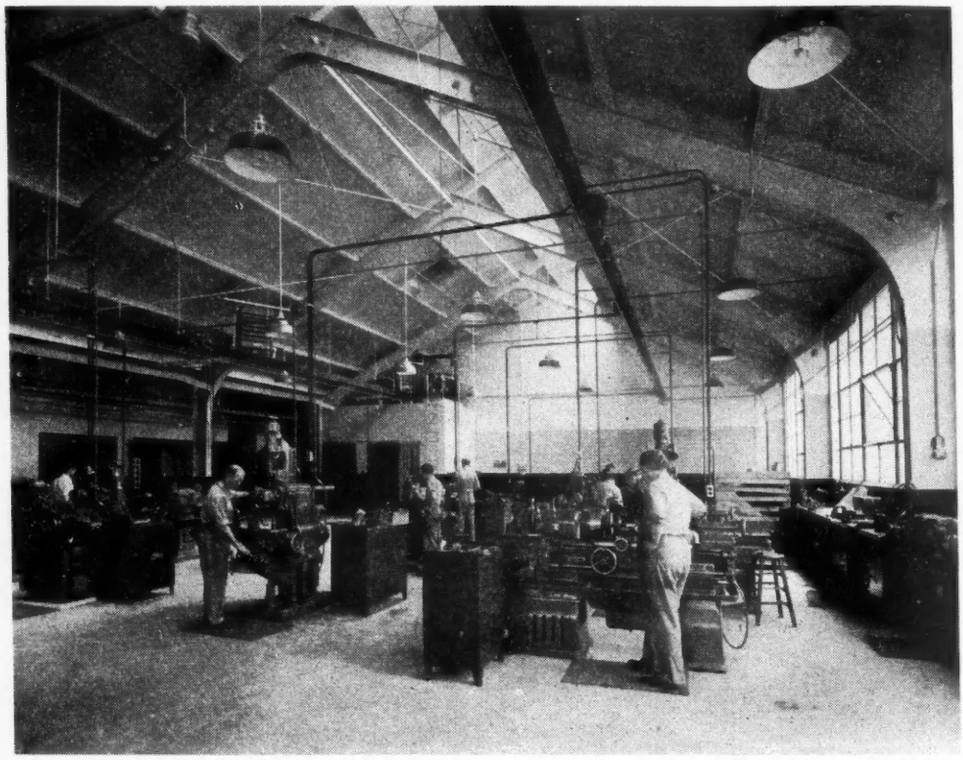
TORRINGTON NEEDLE BEARING



Photo, The Austin Company

This experimental machine shop in the Cummins Engine Company's new research and testing laboratory at Columbus, Indiana, enjoys the advantage of extraordinary daylight working conditions, provided by a new welded rigid frame cross-section with a whale-back fin which admits abundant roof light above the peak of the rigid arch.

New Research Building for Cummins

THE COMPACT research building for the Cummins Engine Co., Columbus, Ind., designed and built by the Austin Company, has a large experimental machine shop where daylight working conditions have been provided by means of a novel welded "whaleback" cross-section which introduces light through a "fin" supported by a 50-ft. rigid frame arch.

One entire side of the building is devoted to engine testing facilities. Six test rooms, 10 ft. by 21 ft., have been provided, and each is equipped with a monorail and chain hoist of two or five ton capacity to facilitate the mounting of engines and their removal from test blocks. Individual ventilating fans, engine exhaust vents and fluorescent tubes mounted directly above the test blocks in each room provide ideal conditions for accurate testing and observation.

Observation corridors located between each pair of test rooms have been equipped with all the required meters and control instruments for test operation. With dynamometers which control engine loading and other instruments compactly arranged on either side of and above double glazed observation windows, in these corridors, test operations in rooms on the two sides of each corridor can be observed from a single position. In this way, a single operator can oversee and make the necessary recordings for tests on two engines at once.

Control equipment, including a tachometer, revolution counter, recording thermometers, pressure gages for supercharged pressure, water pressure gages for both front and rear of the block and cylinder head, fuel and lube oil pressure gages, vacuum gages for the water intake and those required to measure air intake of supercharged engines and fuel consumption, is all located outside of the test rooms in the observation corridors.

To check temperatures, a Leeds & Northrup potentiometer with switches is used. With this instrument temperature readings can be taken at various points on the engine at all times.

Valves are studied from the standpoint of valve cooling, seat wear, design of ports and heads, seat cooling, inserts and many others. A "Strobotack" is used to study the spring action, valve seating at various speeds and loads, rocker arm action, etc.

When an engine is being tested, all of the lubricating oil used is weighed on an accurate scale having 1 oz. graduations. A lubricating oil tank rests on the scale. Using a float mechanism in the crankcase, the oil in the tank is automatically fed to the engine to maintain a constant oil level. Thus, while the engine is running, the oil consumed is accurately weighed. This method eliminates any possibility of error which

(*Turn to page* 427, *please*)

NOW – 30% TO 40% EASIER STEERING
FOR HEAVY-DUTY TRUCKS AND BUSES

ROSS

Roller-Mounted Twin-Lever Type

CAM AND LEVER

STEERING GEAR

Complete Stability
for High Speed Driving

Steering Ease

THE NEW GREYHOUND SUPER COACH

Ross

GREYHOUND DEMANDS THE BEST AND AGAIN CHOOSES ROSS

Selection of Ross Steering for Greyhound's new Super Coach is in accord with the high standard of excellence rigidly demanded in every mechanical detail of Greyhound coaches.

CAM & LEVER STEERING

with Stability

YOU NEED BOTH
AND ROSS GIVES YOU BOTH!

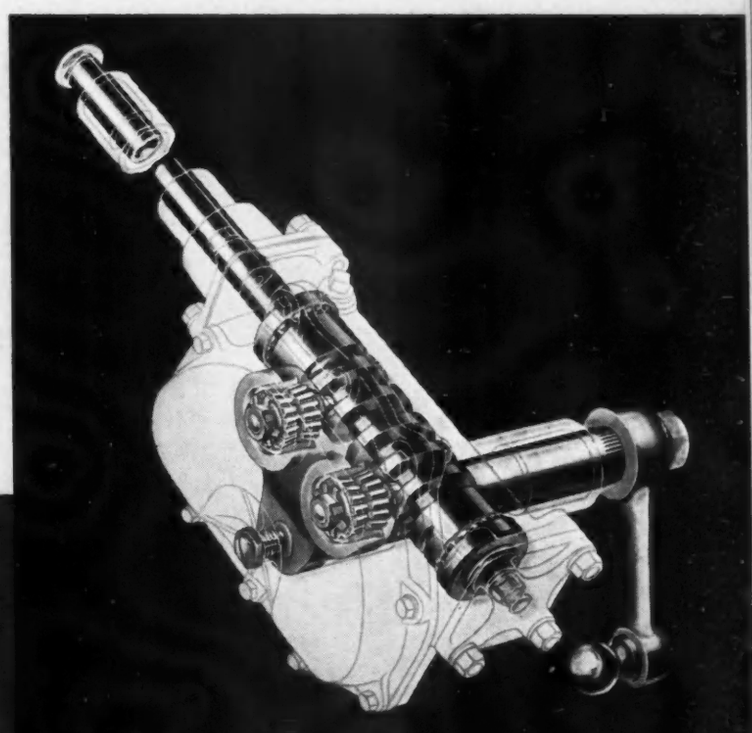
MAXIMUM steering ease and stability—in just the right *combination*—are of vital importance in steering any automotive vehicle. Ross, through its basic and exclusive cam and lever principle, meets these two requirements in a degree never before achieved.

For many years and for millions of miles, Ross Steering has served Greyhound well, and still does. Ross finds satisfaction in being chosen again by Greyhound to steer the new Greyhound Super Coach. It is a significant fact that a large majority of all heavy-duty trucks and coaches today are equipped with Ross Cam and Lever Steering.

During more than thirty years Ross has anticipated and met the changing and increasing needs of automotive operation with constantly improved steering gear design.

Whatever your steering needs may be, Ross is prepared to meet them economically, and to your complete satisfaction. We invite discussion of any steering problem.

ROSS GEAR AND TOOL COMPANY
LAFAYETTE, INDIANA



● *The new Roller-Mounted Twin-Lever Type Ross Gear, embodying the basic and exclusive cam and lever principle.*

ROSS ROLLER-MOUNTED CAM & TWIN-LEVER STEERING GEAR GIVES THESE OUTSTANDING ADVANTAGES OVER SINGLE-LEVER ROLLER-MOUNTED UNIT

Variable Ratio—(a) Produces greater ease in parking: 45 percent leverage increase. (b) Gives better control at high speeds. Road sense maintained in driving range.

Increased Angular Arm Travel—A full 100 degrees of angular arm travel, compared with 76 degrees in single-lever unit, greatly improves maneuverability as shorter turning radius can be obtained. Mechanical advantage is likewise stepped up 30 percent.

Mechanical Efficiency—Average efficiency increased in straight-ahead driving range 12 percent. Efficiency in parking range, where heaviest steering load is encountered, increased 24 percent.

Capacity—Unit is subject to lighter loading through use of shorter steering arm. Road shock minimized. Contact area between cam and lever increased 100 percent. Internal working pressures reduced 50 percent on cam surface and 20 percent on thrust bearings.

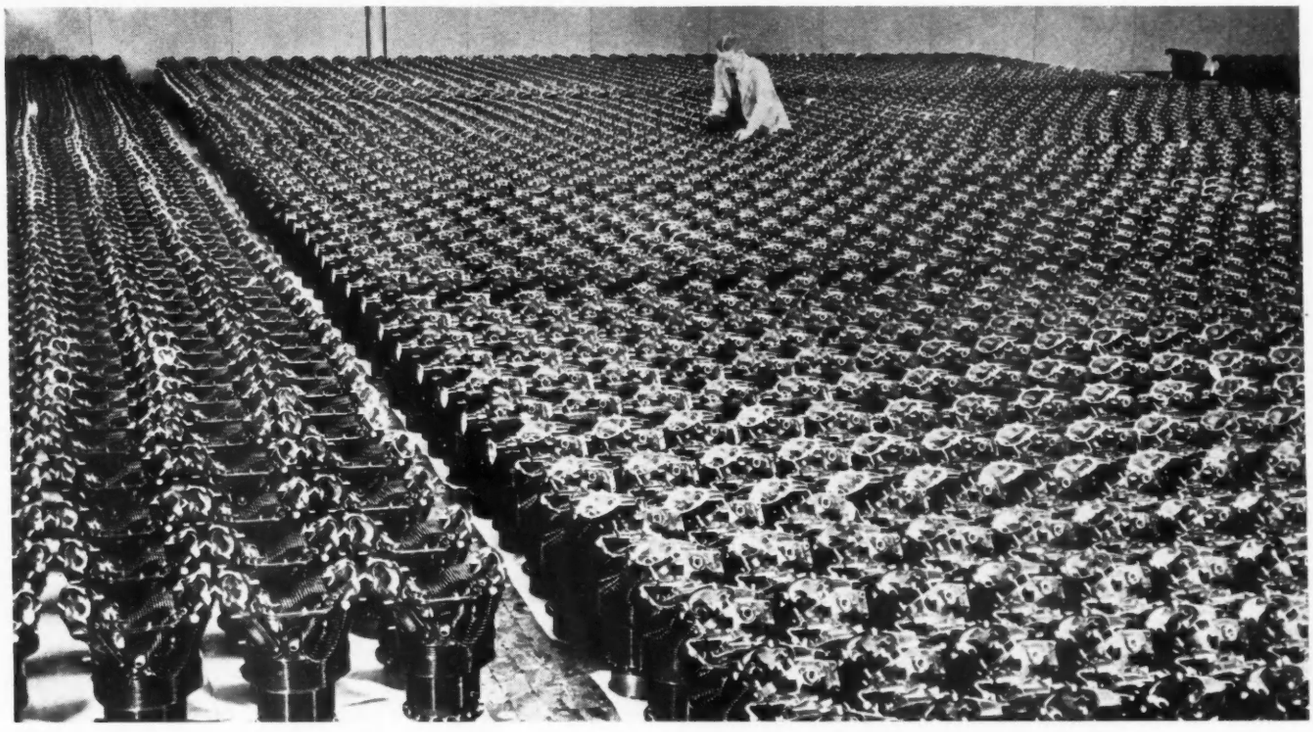
Steering Efforts—As a result of better balanced ratio, increased angular arm travel and shorter steering arm, plus the increased mechanical efficiency designed into the new unit, *overall steering efforts in these new Twin-Lever Roller-Mounted Steering Gears are reduced from 30 to 40 percent.*

Precision—Cam and lever parts are ground on all working surfaces to close limits, resulting in smooth operation and long life. Necessity for wear adjustments reduced 33 percent.

Simplicity of Construction and Adjustment—Existing advantages in Ross simplicity and stability of adjustments are maintained.

ROSS GEAR AND TOOL COMPANY • LAFAYETTE, INDIANA

AVIATION



FACES BIGGEST PRODUCTION PROBLEM

By LESLIE PEAT

A MOMENTOUS decision is now being made by the American aircraft industry and the government to make the present national defense program succeed:

Aircraft, engine, and accessory designs are being "frozen" to get aircraft into production.

"Freezing" the design of a single airplane, with its many thousands of parts, would be a gigantic task. But the national defense program calls for aircraft of many types, ranging from primary trainers to powerful fighting craft including the heavy "flying fortresses." In this program are land planes for the Army and sea planes for the Navy.

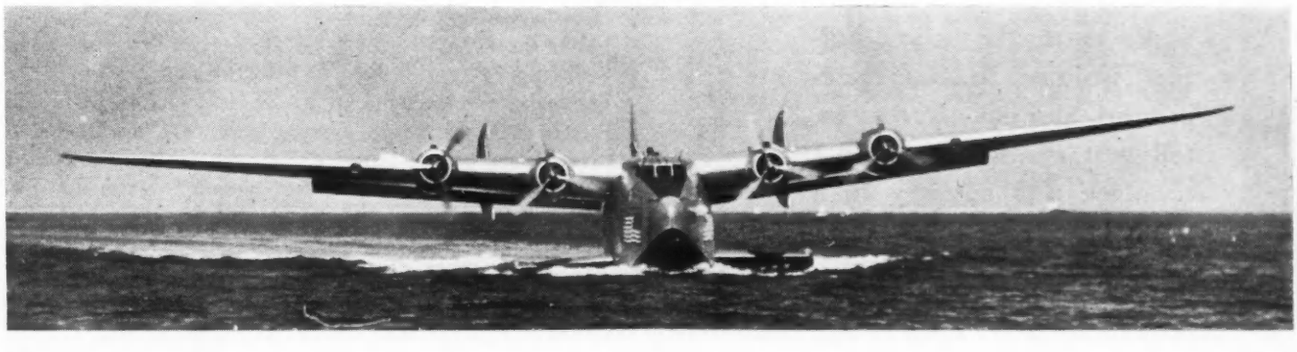
After the types have been selected, there is a vast amount of work to be done in deciding upon the best accessories and instruments. These, as well as the aircraft, must be studied in the light of recent European warfare experience.

Only after these thousands of carefully-considered decisions are made and design has been "frozen" can the production men bring the manifold schedules into a working pattern of mass production.

The question of inspection looms large in aircraft manufacture. Without some revision of requirements this stringent phase of production will effectively bottleneck production. Some modifications have been

The American Clipper has proved the efficiency of this type of plane for long range travel.

Soilbelman Photo



International Photo

High speed Curtiss pursuit planes are shown in mass production at Buffalo, N. Y., factory of Curtiss-Wright Corp. More than a thousand of these speedy fighters are on order for the U. S. Army Air Corps.

Arthur Nutt, Vice. Pres. Wright Aeronautical Corp.

Says: If a parallel can be drawn between French difficulties and what is going on in this country, then something should be done with the least possible delay to correct the situation here by avoiding their mistakes, as well as the mistakes we made in the last war; putting politics in the background, and substituting intelligent coordinated effort to place this country in a satisfactory position for national defense.

approved, and others are being studied at this time.

Already many design compromises have been effected in the interest of national defense. Many of these compromises appear to outstanding aircraft engineers as backward steps, and sadden many men. Some go so far as to say that already structural strength and performance are endangered, but others hold that the most important consideration today and next year is speedy output of fighting aircraft.

Today the aircraft industry presents several striking parallels to the conditions in the automotive vehicle business of two and three decades ago. Then hundreds of makes of automobiles were available, but the production rate on many models was antiquely small, even as compared with our present high-priced cars. Most were virtually custom-made. We see something of this in today's motorbus manufacturing schedules. Since then that large number of makes has been boiled down to few, but out of the cauldron has come well over 50 million cars and trucks and the engineering technique known as mass production.

Of the hundreds of types of aircraft, engines, and accessories we will find relatively few types rolling off the production lines for national defense. But already they are coming off at rates unprecedented in American aircraft history.

The "we want next year's models this year" attitude of the Army and Navy has been a great stimulus to advances in engine and aircraft performance. Several

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The words, "Cut by the Maker," on the familiar Trade Mark of Western Felt Works, have special significance to the aviation industry. They mean that every one of the numerous standard and special uses of FELT is supplied accurately by this large, modern plant, completely equipped to manufacture any required FELT and then, if desired, cut it to specifications.

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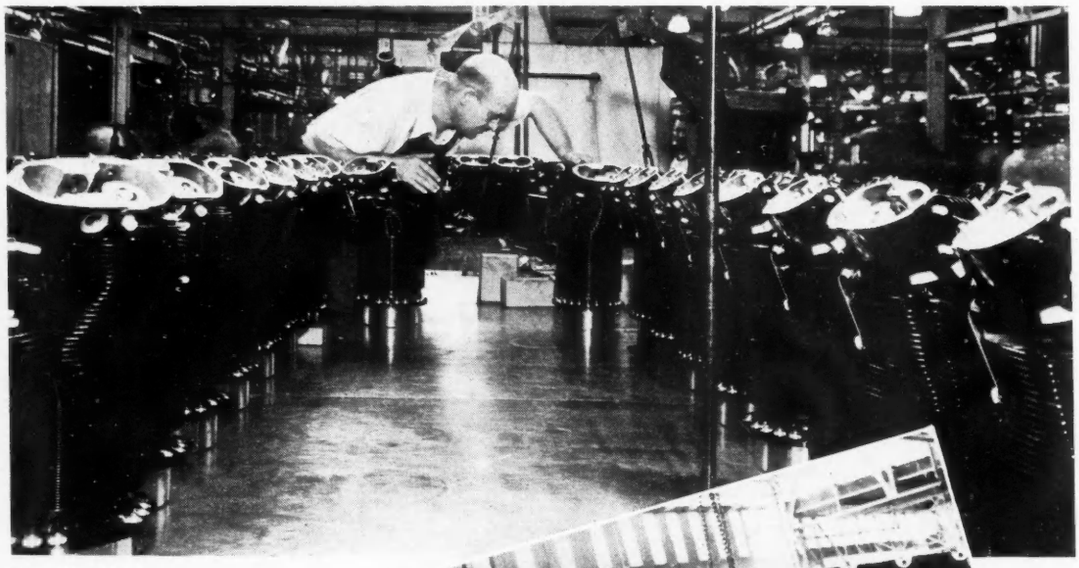
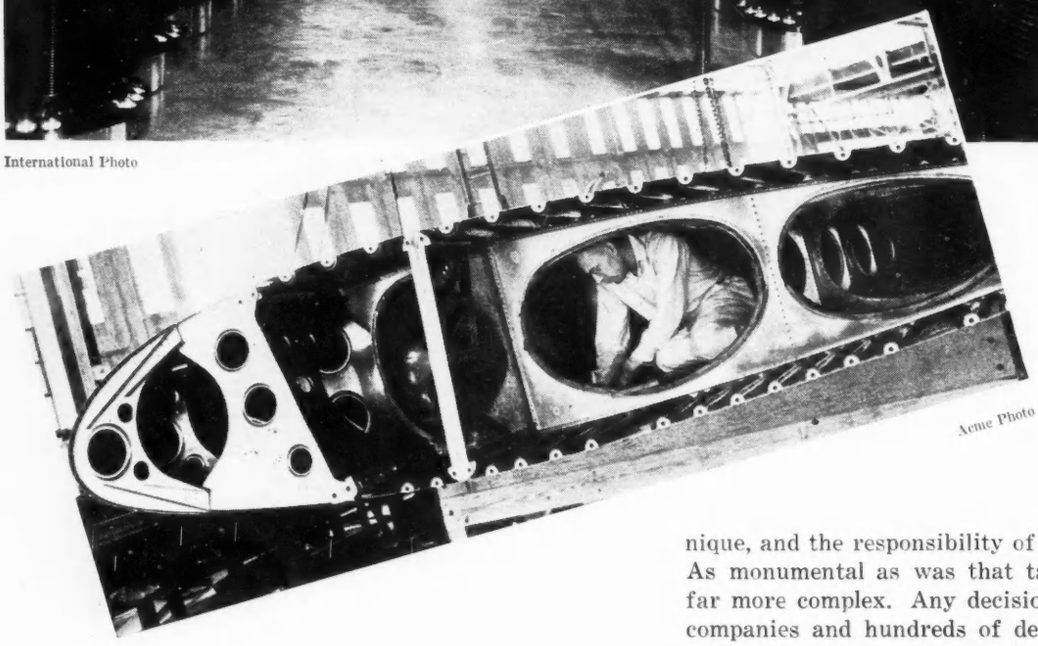


International Photo

The Wright Aeronautical Corp. motor-making plant, Paterson, New Jersey. A craftsman is shown examining two lines of housing cylinders for the "Cyclone" 14-cylinder engines that develop 1600 to 1700 horsepower apiece.



Acme Photo

The cross-section view of the wing. Space is provided in the wing for four fuel tanks having a total capacity of 1,000 gallons. Wingspread is 108 feet.

well-informed engineers believe that the present war has demonstrated that American aircraft and engines are from two to three times as useful, in terms of serviceability and fighting power, as are overseas makes. The conflicting requirements of the government for fast and maneuverable aircraft on the one hand, and the demand of the commercial airlines for durable, safe aircraft on the other hand, has stimulated our designers and manufacturers to this remarkable achievement.

When Henry Ford "froze" the Model T he gave the artistic and aesthetic sensibilities of the world a shock. But he got cars into production—by the million. His was the final decision in every phase of design and manufacturing technique, and the responsibility of his plan was his alone. As monumental as was that task, the present job is far more complex. Any decision made involves many companies and hundreds of designs. Some time ago, a high-ranking American officer belittled the design of the Messerschmitt: "It looks like a mess," he was quoted in the newspapers. He did not add the most significant fact, namely, that these airplanes are produced in quantity for the German air force and that

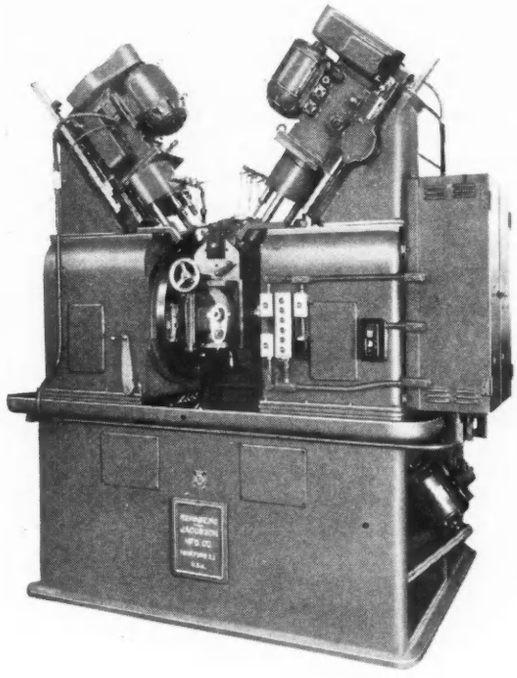
International Photo

All-metal fuselages and wings which emerge from the production line as fighting planes of the new, fast, heavily armed Curtiss advanced pursuit type for delivery to the U. S. Army Air Corps.

Airplane Manufacturers Increase Production In National Defense Program

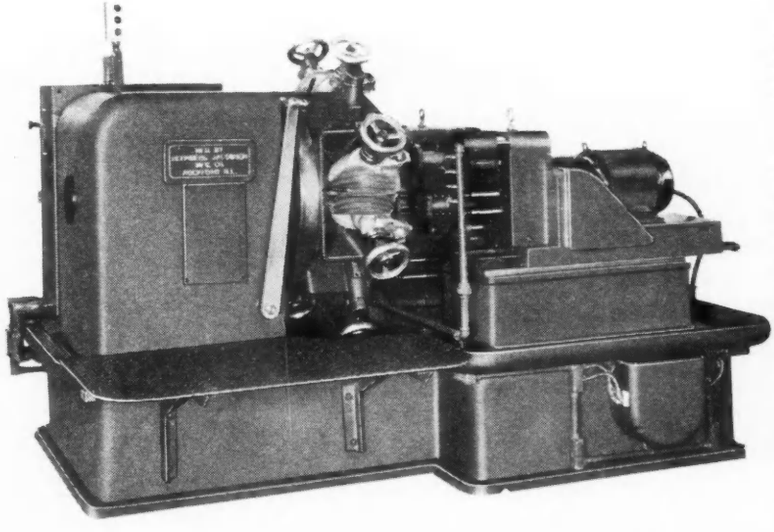
with

REHNBERG-JACOBSON MACHINES



With the forces of industry solidly arrayed behind the National Defense Program, high-speed production has become an actuality. With tremendous increases called for in air, land and sea forces, airplane manufacturers are faced with an unprecedented production problem. To meet this urgent call for planes and materials the foremost companies have installed REHNBERG-JACOBSON machinery in their plants. Precision-built, these machines afford maximum production at minimum labor and time costs.

(*Left*) A six-way four station indexing machine built for a prominent airplane motor manufacturer. In three operations, this machine completes eight rocker arm cover holes in the cylinder head. Four self-contained hydraulic units progressively drill and countersink these holes, while tapping operation is accomplished by two self-contained lead screw tapping units. With a flexibility of fixtures permitting the machining of five sizes of cylinder heads, this machine will produce 250 cylinder heads per hour.



(*Left*) A machine designed to drill, countersink and tap, progressively, the intake and exhaust manifold screw holes on airplane cylinder heads.

A four-station index turret positions cylinder heads accurately before three slides carrying multiple spindle heads. All slides are actuated by cams on a central camshaft. Head on the tapping slide is started on an individual tapping cycle when slide engages a positive stop. With production capacity of 320 cylinder heads per hour, the unit has a flexibility of fixtures, plus interchangeable spindle heads permitting the machining of five different sizes of cylinder heads.

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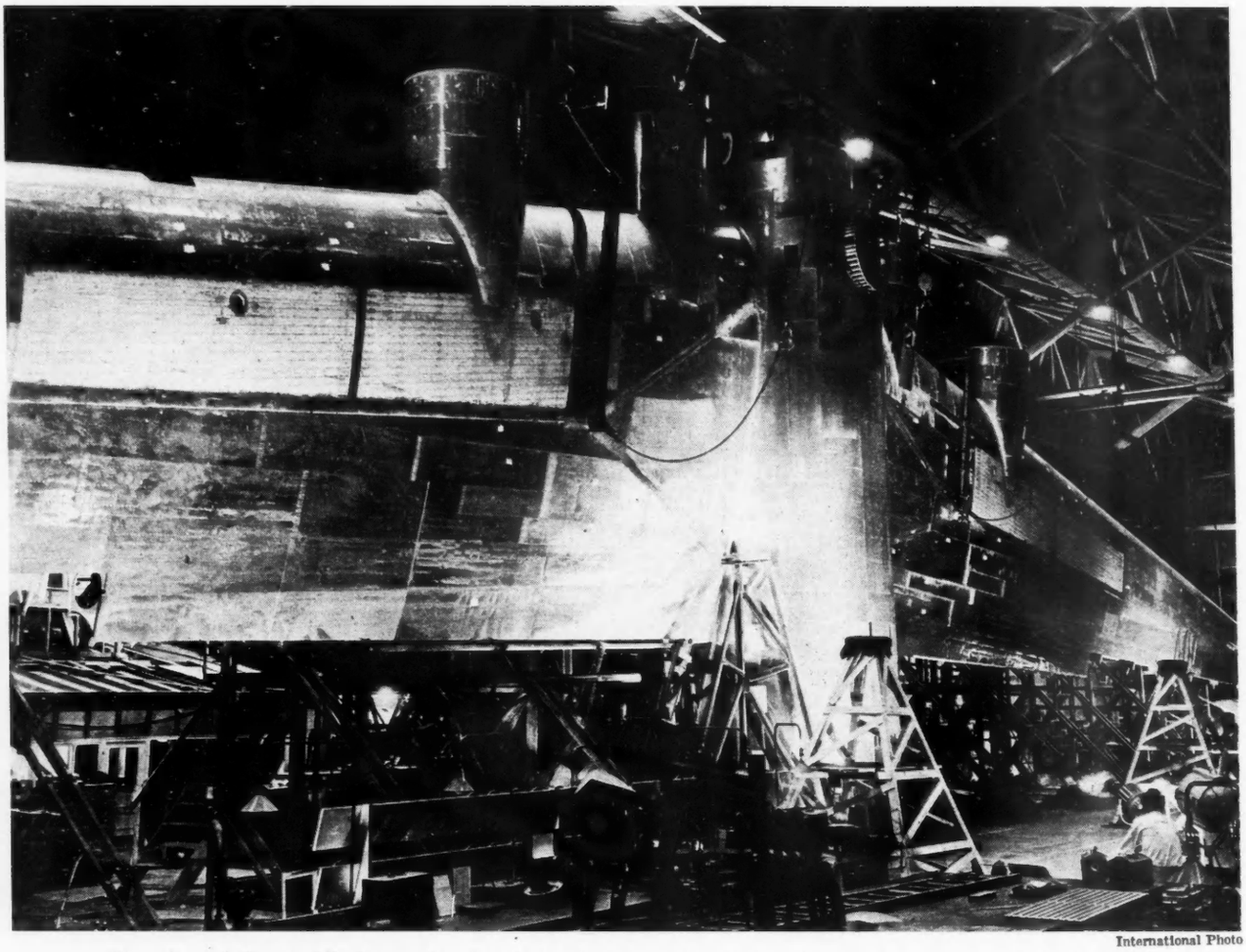

International Photo

The wing of the world's largest bomber being built for the Army. The wing spread is 210 feet. A special hangar has been built to house it at the Douglas plant in Santa Monica, Calif.

International Photo

The East Hartford plant of Pratt & Whitney airplane motor manufacturers showing some of the hundreds of aluminum alloy pistons which must be turned out each day. The completed engine is given a six-hour test.

they are giving excellent account of themselves. Long ago, in terms of the world holocaust, this and a few other designs were "frozen" and German production men got busy.

What would be accomplished if a group of motor vehicle designers collaborated on an airplane design? Certainly it could be manufactured on mass production schedules. Car and truck competition has taught vehicle designers to think in terms of manufacturability. Their designs must be converted into parts quickly, and at the lowest possible cost of material and labor. But this hypothetical airplane would fall far short of the needs of national defense. And unless an airplane is good, it isn't worth building at all. Speed is the most important economic asset of an airplane, and *more* speed and a high degree of maneuverability is the prime requisite of military aircraft.

Who, then, are these aircraft designers? Who are these men of vision who created for all of us this new huge industry from their fertile imaginations? A few short years ago many of them were making and flying kites; then some of them made and flew model airplane of their own design. They carried on extensive back-yard air meets. All of them had the "feel" for flying and aircraft designing. Many went deep into the fundamentals of engineering. They, with

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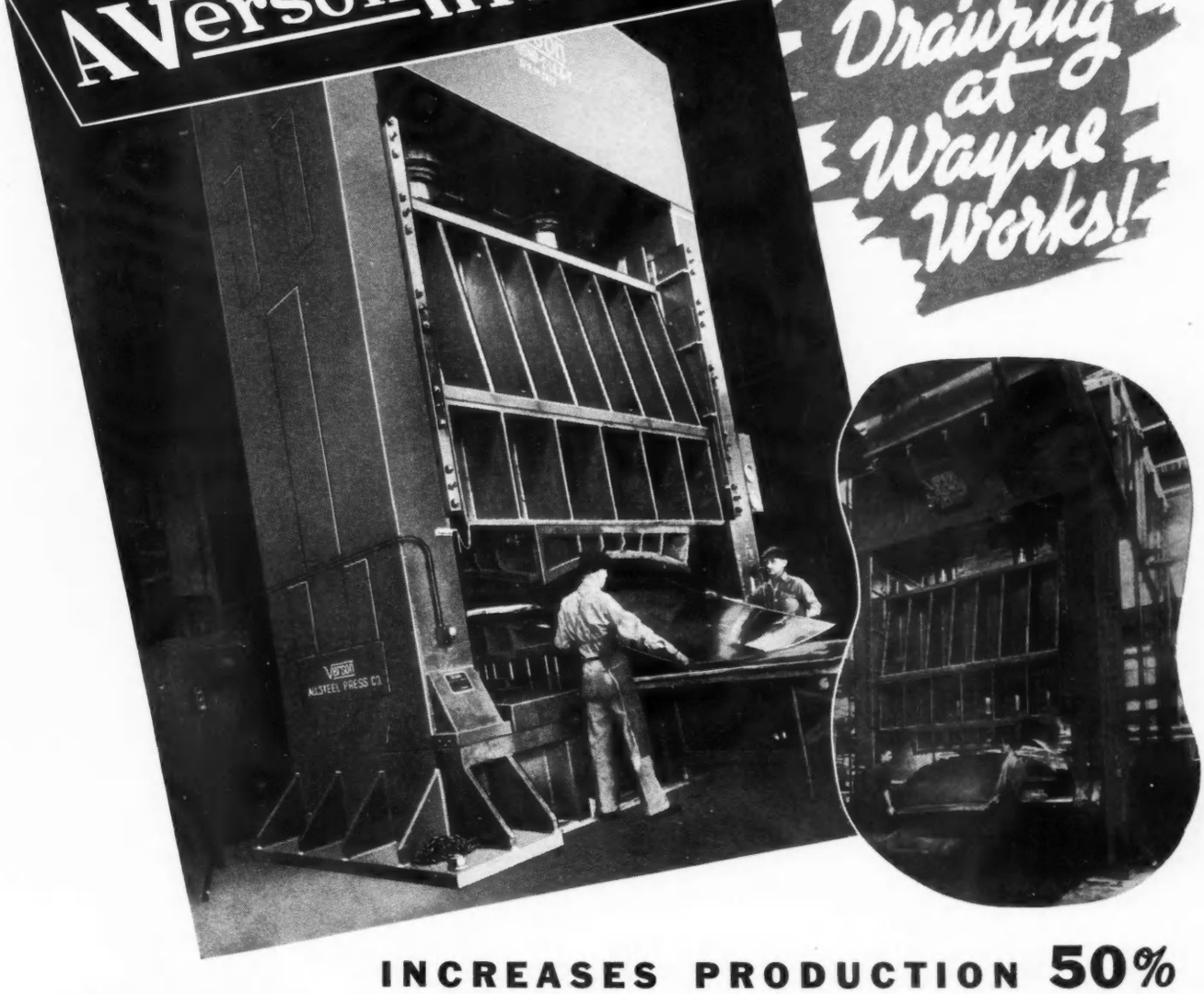

INCREASES PRODUCTION 50%

THIS 850 ton Verson Hydraulic speed press, equipped with Verson Hydro-Pneumatic cushions, a 42 in. adjustable stroke, 100 in. daylight space, a 95 in. x 144 in. bed area, produces 300 finished front deck bus panels per hour. Previously, production on this part was restricted to 200 pieces per hour with other equipment.

The drawing of 18 in. deep rear compartment sections, measuring 69" x 76" finished, are produced at the rate of 150 per hour.

Here is another example of how Verson products have helped manufacturers increase production—improve products and lower costs.

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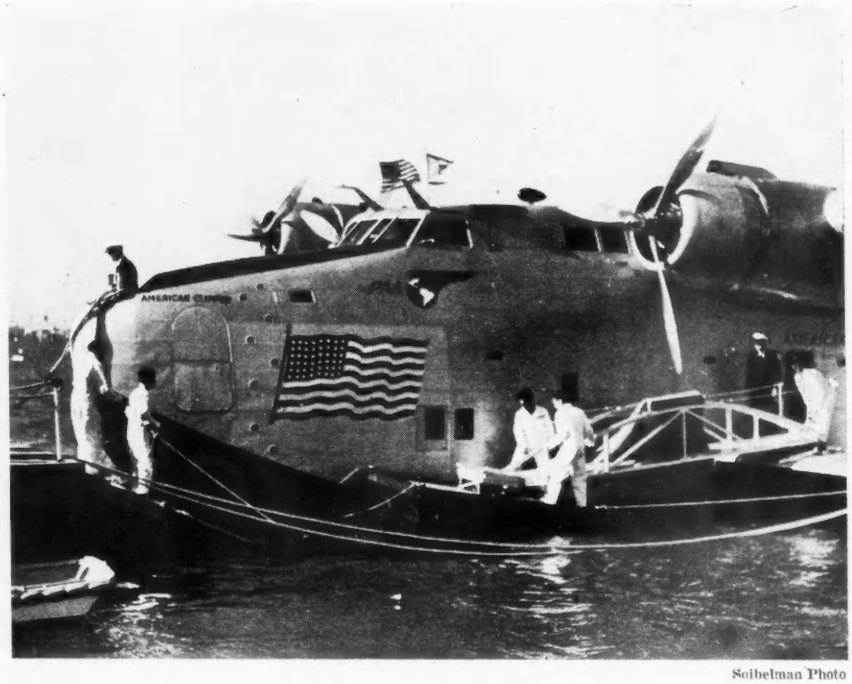


Seibelman Photo

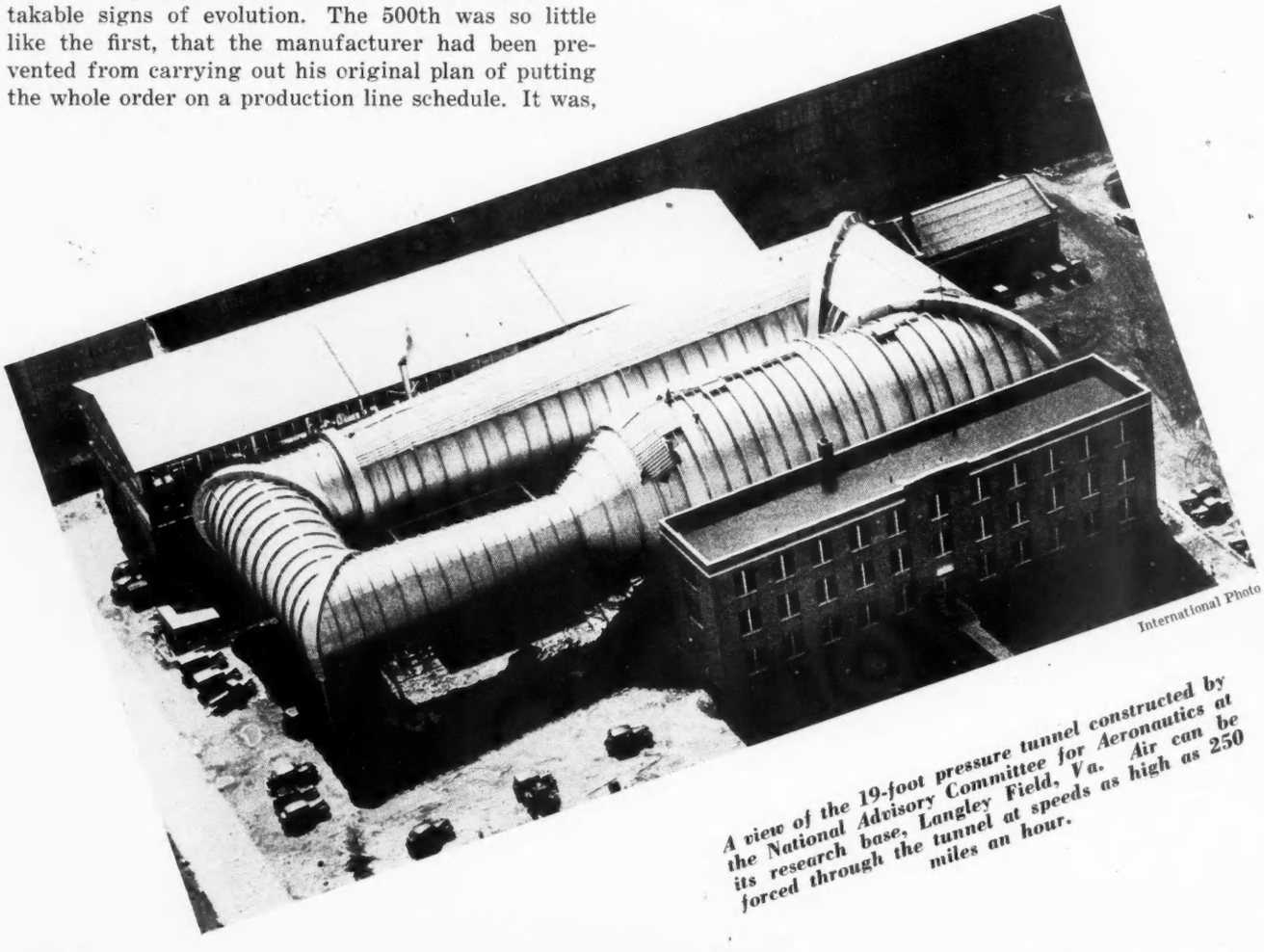
The American Clipper which covers a route between Los Angeles and New Zealand is typical of many of the planes under construction for the defense program.

even younger men who have come along, have startled the imagination of the world from before and since Kitty Hawk.

During its infancy the industry carried on its competitive battle for faster and safer aircraft. They who had built kites kept on building aircraft with the same starry-eyed fervor. Their designs ran into the hundreds. And at the dawn of the European war, the Army and Navy had on hand a smallish inventory, but a conglomeration of types beyond belief. But these men have peered into the future in respect to design-for-production, as well as design-for-speed and maneuverability.

But until now manufacturers of fighting craft were unable to swing into mass production; there were no such orders for aircraft. A recent order for 500 airplanes was subjected to so many changes thoughout the entire program that there was seen the unmistakable signs of evolution. The 500th was so little like the first, that the manufacturer had been prevented from carrying out his original plan of putting the whole order on a production line schedule. It was, in effect, an order for a series of custom-made airplanes, and not a 500-lot order at all.

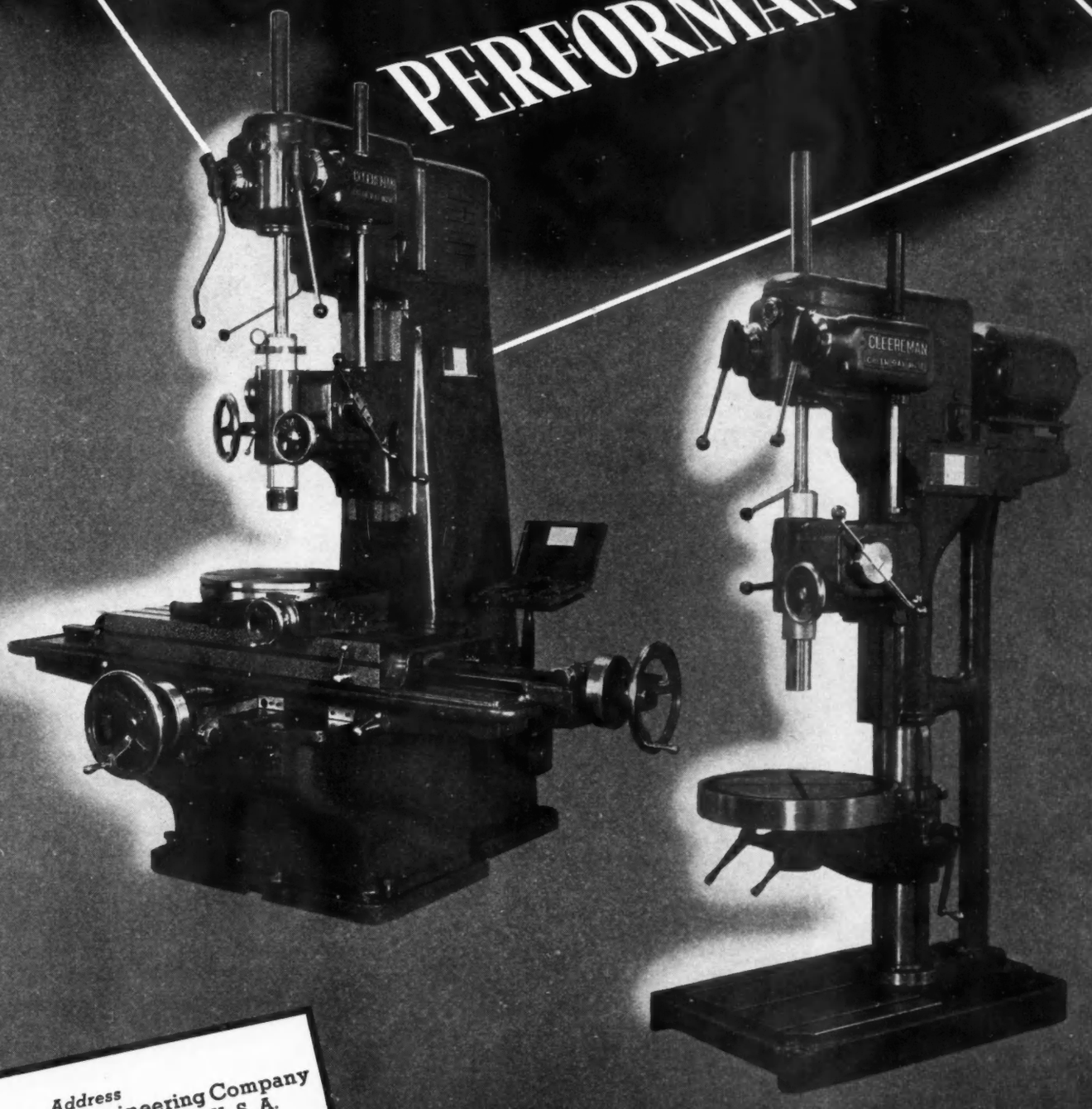
The aircraft industry is avid to adopt mass production techniques, but in the face of the experiences of



International Photo

A view of the 19-foot pressure tunnel constructed by the National Advisory Committee for Aeronautics at its research base, Langley Field, Va. Air can be forced through the tunnel at speeds as high as 250 miles an hour.

NEW STANDARDS OF PERFORMANCE



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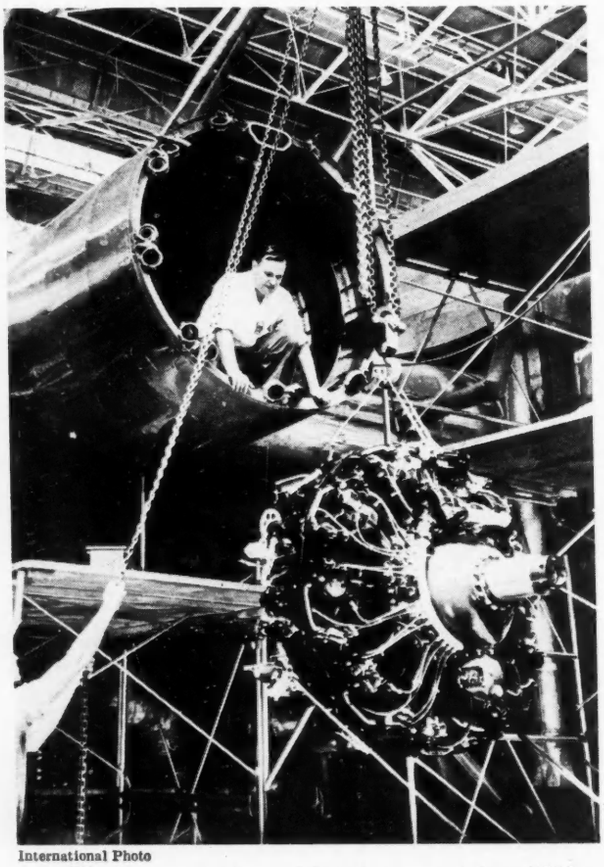
International Photo

This view shows one of the floors in Boeing plant No. 2, Seattle, where rows of wing panels for the four-engined bombing planes, known as Flying Fortresses, are completed to feed the assembly line. The wings are complete with landing gear, engine nacelles and virtually all installations except the engines themselves before release from this department.



International Photo

Workmen are pictured hoisting one of four 2000 horsepower engines in place in the wing of the world's biggest bomber being built for the Army by the Douglas Aircraft Co. at Santa Monica.

the past ten years, it has not had an opportunity to show the country what it can do.

Let no one fear the inept warning of those who say: "Design 'freezing' stops progress." Every year, about twelve months before automobile show time, car designs are "frozen" for production. Yet year after year we will see important automotive developments and improvements, based on extensive and long research programs, roll off the production lines of the automobile factories.

No sane man would wish that the aircraft industry—or any other enterprise in this country — grow out of its dream stage. Dreams are the prime movers of the American way of life. While the research and development projects are continuing, while dreams are being made into things that can be sold for profit, production men will be putting last year's dreams into useful, finished products. With the development work going on apace, development work will be continued for "freezing" these new designs sometime in the future. Then, again, compromises must be made and production schedules fixed if there is a continued demand for herculean production schedules of aircraft.

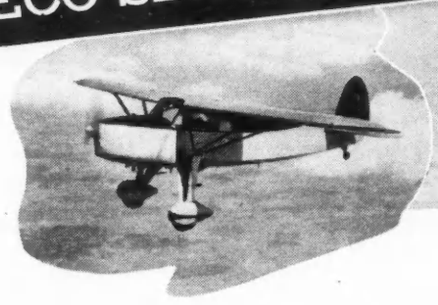
Vehicle manufacturing engineers would be surprised to see how advanced are the manufacturing techniques of aircraft and aircraft engine builders. Visits through such plants are rare these days, but bank after bank of fully-automatic machine tools, continuous heat-treating and plating processes, automatic foundry equipment, and other up-to-the-minute machinery would make vehicle engine production men feel quite at home. Many would be amazed at the mass precision production schedules already achieved.

Yet all this has been accomplished in the face of small production schedules for any one of the many engine types. The nation may feel confident that the industry is undertaking its gigantic task with the whole metal-working industry behind it.

For years the prospect of large orders—someday—has resulted in a huge outlay of capital for research and development work, manufacturing plants, and modern high-production machine tools. Some of the machinery had to be designed for aircraft and engine production. New alloys, both ferrous and non-ferrous, had to be developed and tested. This investment can only be paid out in large-scale buying. Furthermore, in the process of "freezing," some of the developments

HOW ADECO SERVES AIRCRAFT MANUFACTURERS

New Ranger engine-equipped training planes a
Curtiss combat ships incorporate gears, hydrau
assemblies, and other precision parts produ
by ADECO.



Today, more and more aircraft manufacturers are turning to ADECO craftsmanship for the development and production of precision parts and complete assemblies for both gasoline and Diesel-powered craft. Here are master craftsmen with complete laboratory facilities for developing, engineering and testing vital parts. Here, too, are experienced production specialists equipped to produce fuel injection equipment and precision parts to manufacturers' specifications. ADECO engineers are ready to work with you in meeting your requirements. Let them help you solve your problems.

At right:—Guiberson radial-type Diesel aircraft engine equipped with fuel pumps and fuel injectors perfected and built by ADECO.

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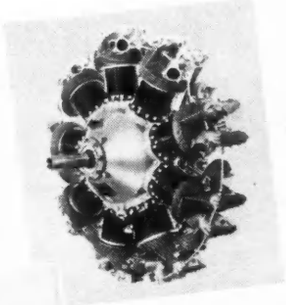
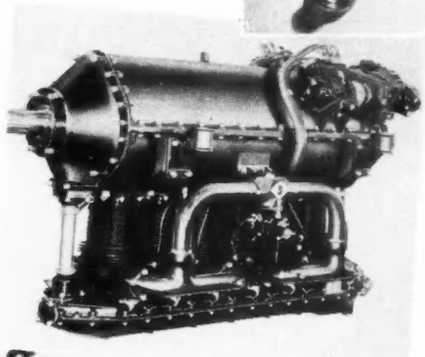
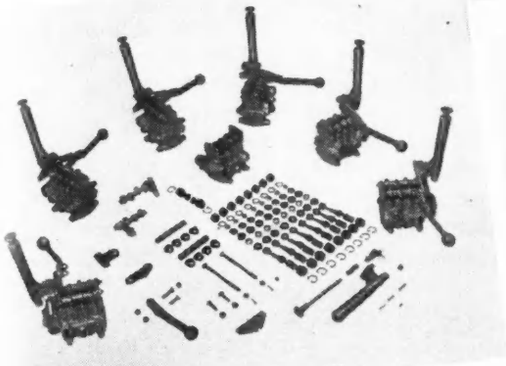
Below:—Hydraulic valves and parts for landing gear and wing flap controls built by ADECO from manufacturers' designs.





Above:—Typical precision parts built by ADECO for aircraft in cooperation with manufacturers. These include gears, shafts and other parts requiring unusually close tolerances. In addition, ADECO produces strut and tube ends, nuts, bearings, spacers, yokes, brackets and special fittings of all types.



Above:—Ranger engine incorporates a large number of precision parts built by ADECO engineers.

•

At left:—Hand pump and parts for hydraulic system controlling landing gear and wing flaps.

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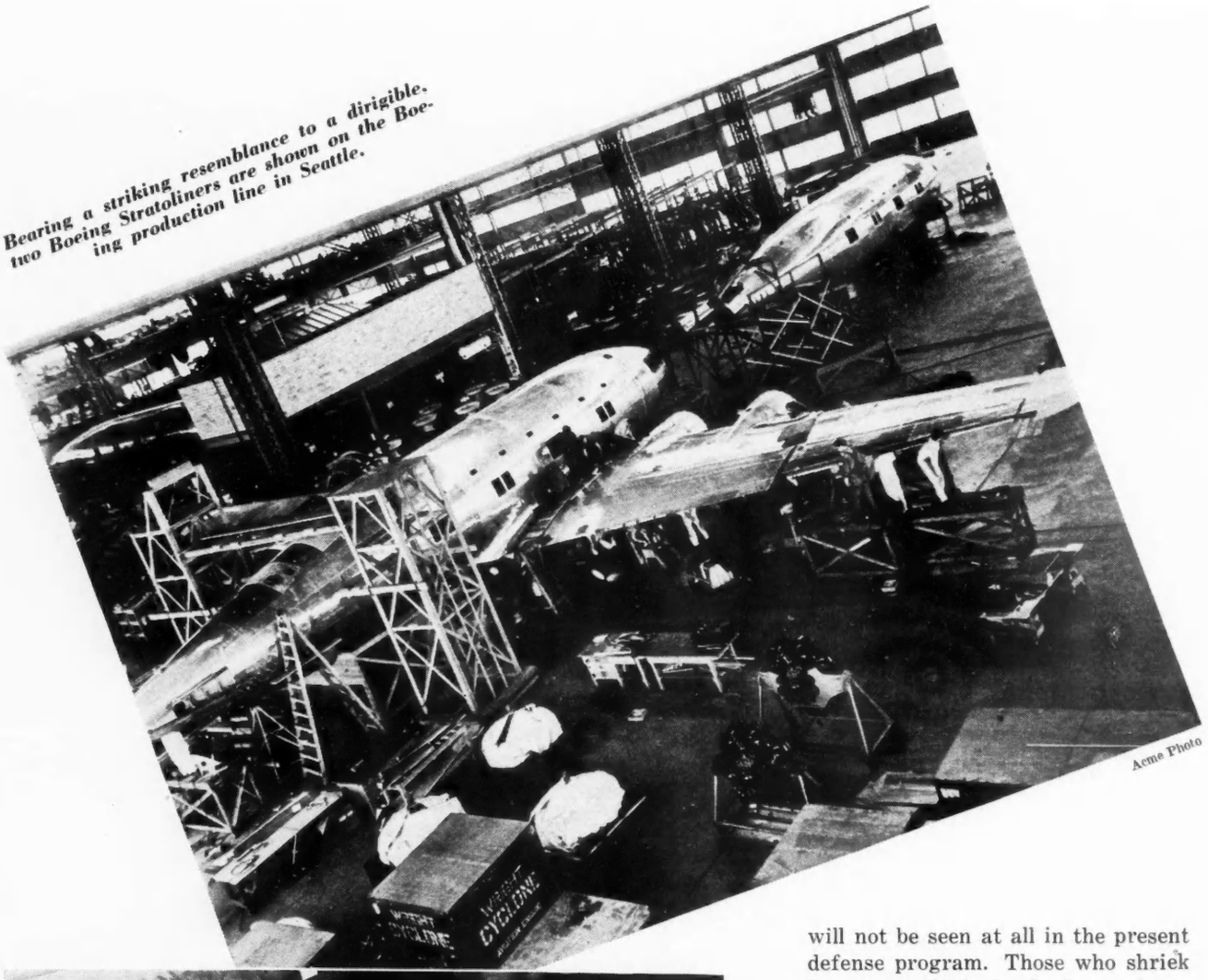


Bearing a striking resemblance to a dirigible, two Boeing Stratoliners are shown on the Boeing production line in Seattle.

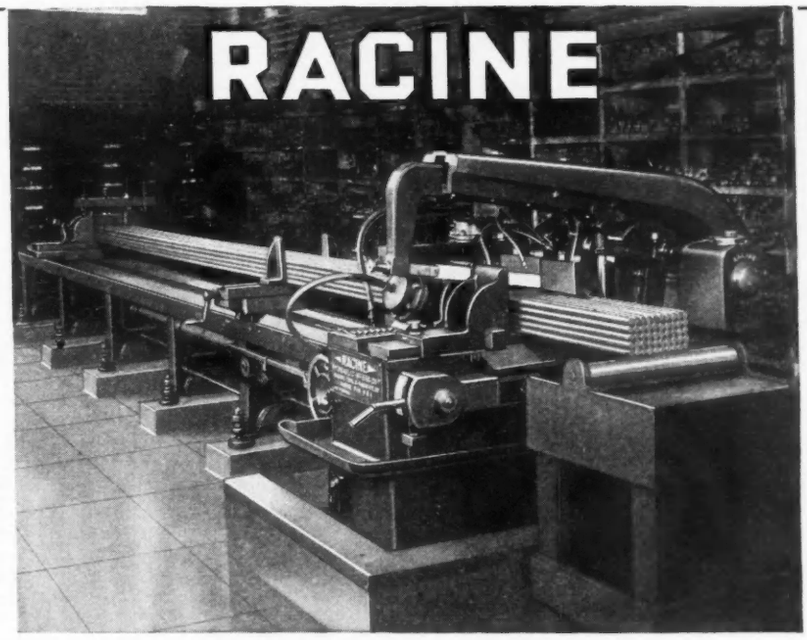
Acme Photo

will not be seen at all in the present defense program. Those who shriek "excess profits" simply do not know some of the simpler facts of life.

The automotive vehicle industry taps almost every kind of business in the country for materials and parts. Thousands of factories throughout the nation may see aircraft supplies or parts on their order books as this emergency program gets underway. On our farms, in our hamlets, towns and cities across the continent, and at sea, we have a potential force of every-day, developed mechanical sense that is second to none in all history. Farmers, ship's engineers, fishermen, garage mechanics, service station attendants, factory and mill workers by the million represent a mechanically-apt source of manufacturing and maintenance manpower without comparison for numbers and in ability.

International Photo

A scene in the plant of the Thompson Products Company, Cleveland, manufacturers of small airplane parts. The girls here are inspecting completed aircraft bolts before they are packed for shipment to buyers.



Right—Fast production of Flannery Bolt Company, Bridgeville, Pennsylvania. A RACINE Heavy Duty Machine cutting fifty 1" bars at once, to uniform lengths in fully automatic cycle.

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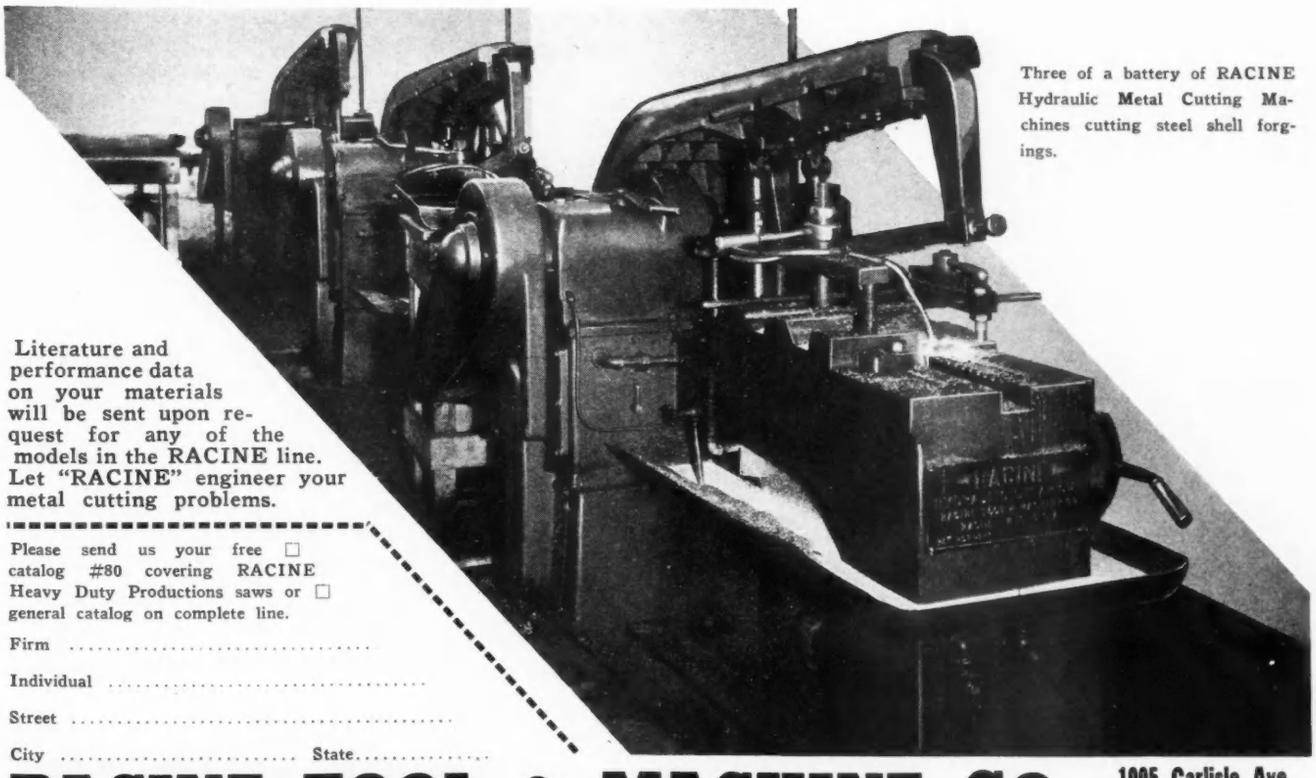
MODERN — In Speed
MODERN — In Hydraulic Simplicity
MODERN — In Accuracy—Economy

In arsenals, in battleships and cruisers, in steel mills, in aircraft plants, in all the heavy industries, RACINE Metal Cutting Machines are used for cutting bars, billets, structural steel shapes, die blocks, etc. Hydraulic feeds and control give smooth, quiet performance and the correct speeds for cutting all types of steel. RACINE Heavy Duty Machines are used to get the fastest sustained production with the longest blade life, wherever metal cutting jobs are tough.

RACINE Heavy Duty Hydraulic Models are available in sizes 10x10 to 14x20. Other RACINE saws in Hydraulic Feed, Screw Feed, and Gravity Feed Types—6x6 to 9x9—are adaptable to every purpose from general shop work to full automatic operation.



Three of a battery of RACINE Hydraulic Metal Cutting Machines cutting steel shell forgings.

Literature and performance data on your materials will be sent upon request for any of the models in the RACINE line. Let "RACINE" engineer your metal cutting problems.

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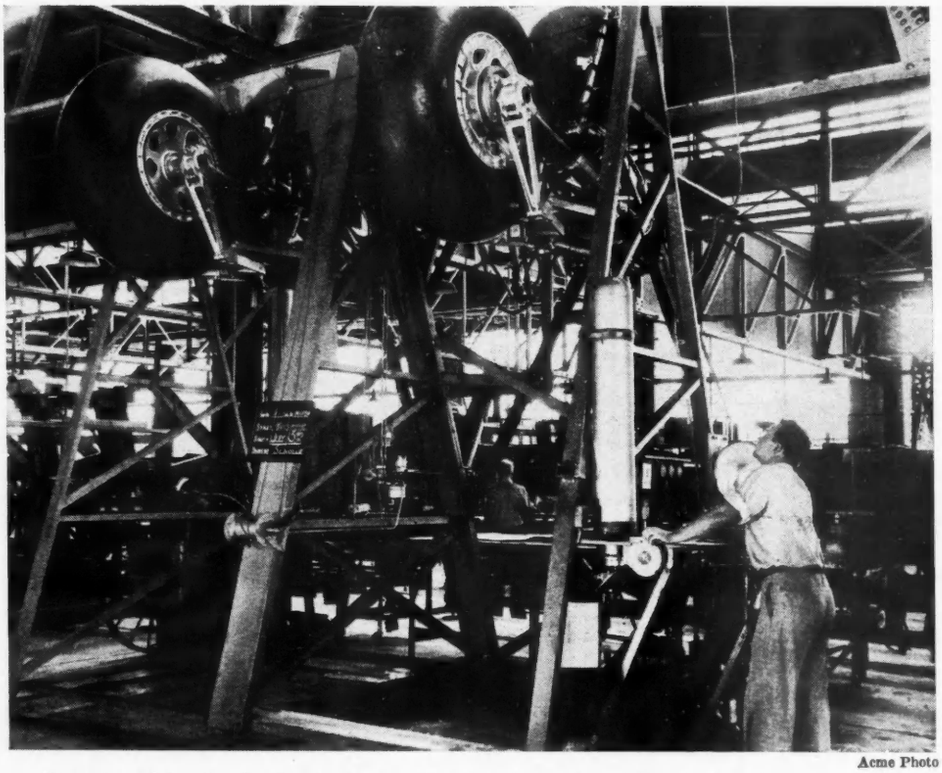
Long before the present emergency, the Army, Navy, Coast Guard, and Post Office departments were supplying some of the funds for aircraft development. The airlines have paid ungrudgingly a large part of the bill. The National Advisory Committee for Aeronautics set up by the Government following the last war, has been carrying on extensive research projects in the interest of faster and safer aircraft. A projected aircraft engine research laboratory, to cost more than $8,400,000, is the newest addition to the NACA program. This indicates the extent of today's government-industry cooperation, which has shown marked improvement during the past few months. For years the National Bureau of Standards has been doing fine scientific work in the interest of advancing mankind's conquest of the air—and his battle against gravity and other laws of nature.



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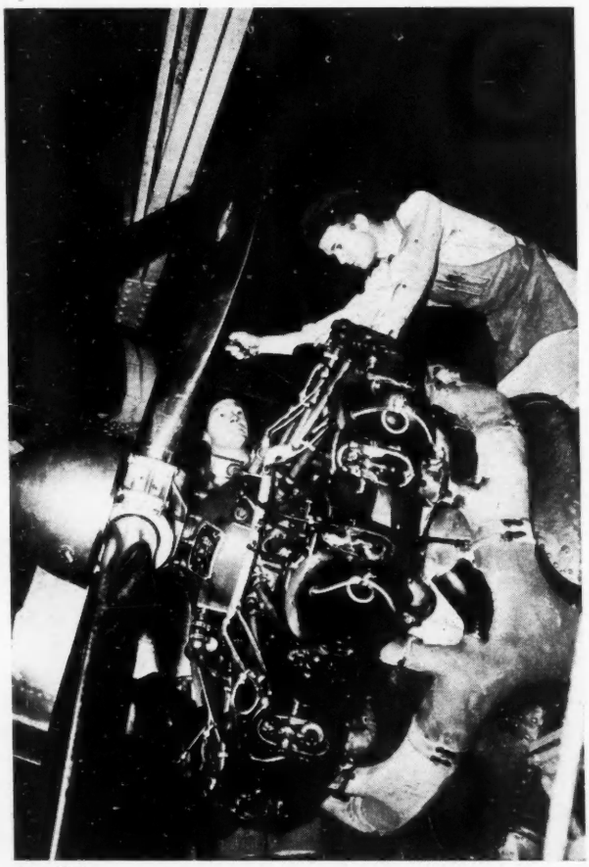
Drop-tested in the St. Louis Curtiss-Wright plant, the airliner's landing gear withstood the equivalent of an 800-foot-per-minute rate of descent. Despite its size, the landing gear is built to retract completely. It is hydraulically operated. Nominal diameter of the main landing gear tires is 55 inches.

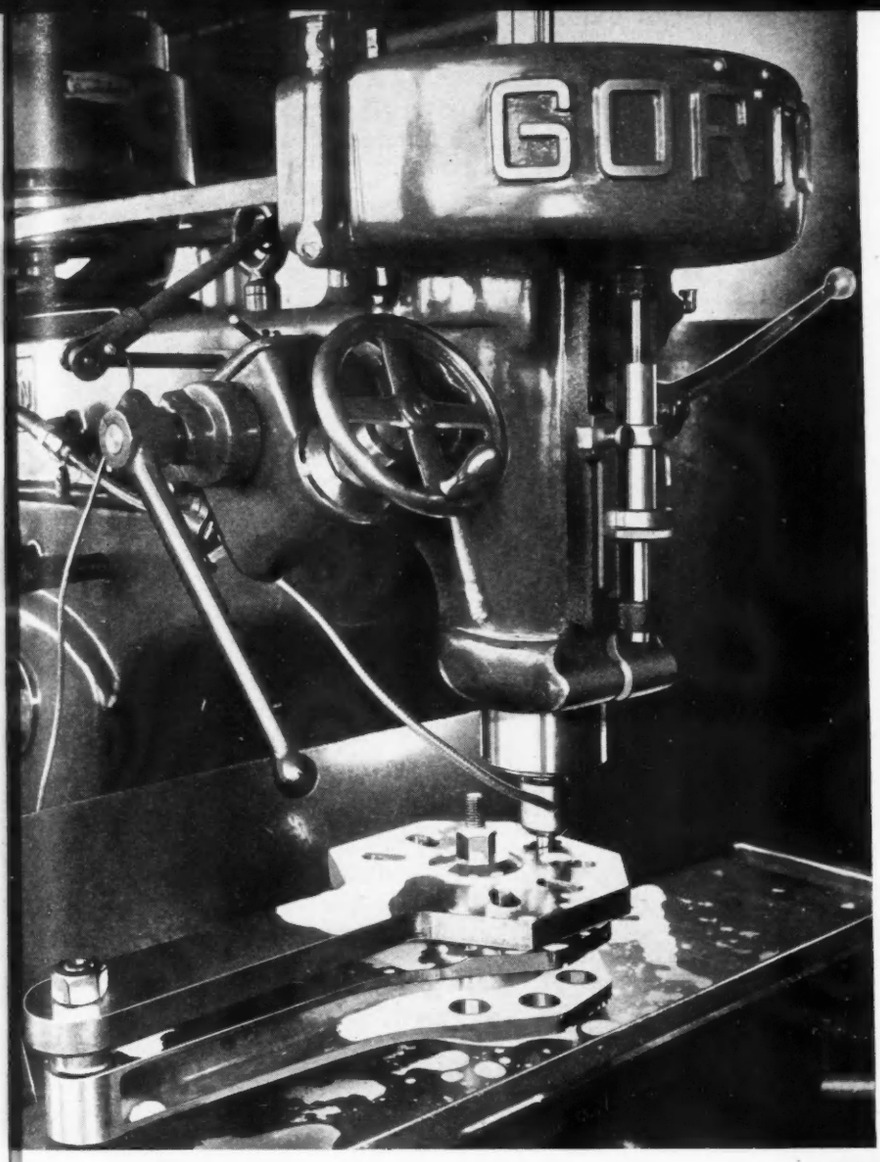


Acme Photo

To get the right type of men, Braniff Airways has in operation in their Dallas, Texas, base an apprentice school for mechanics. After the apprentice has been schooled for three years, he is eligible for a position as a mechanic.

It is also reassuring to the nation that engineers in widely-separated fields are constantly working and checking the work of aeronautical researchers. Through the Society of Automotive Engineers a vast amount of work on aircraft, engines, propellers, carburetion, ignition, and other problems has been made available to everyone interested. The work of the Cooperative Fuels Research of the Society and the American Petroleum Institute stands as one of the most astounding programs of wholehearted cooperation of competitive interests on record. The American Society of Mechanical Engineers, the Institute of Aeronautical Sciences, and other technical societies have made contributions beyond calculation to the industry's advances.

While aircraft production gets started and surges to unprecedented levels the nation can be sure that this wealth of scientific and technical investigation will be stimulated and increased. The present level of aeronautical knowledge is so high, however, that every succeeding improvement or refinement requires vastly more work than ever before. Each of the hundreds of



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TRUE-RUNNING, ECONOMICAL, ACCURATE

CUTTER SPINDLE BRAKE
FOR FASTER CUTTER CHANGES

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NO UNNECESSARY FEEDS
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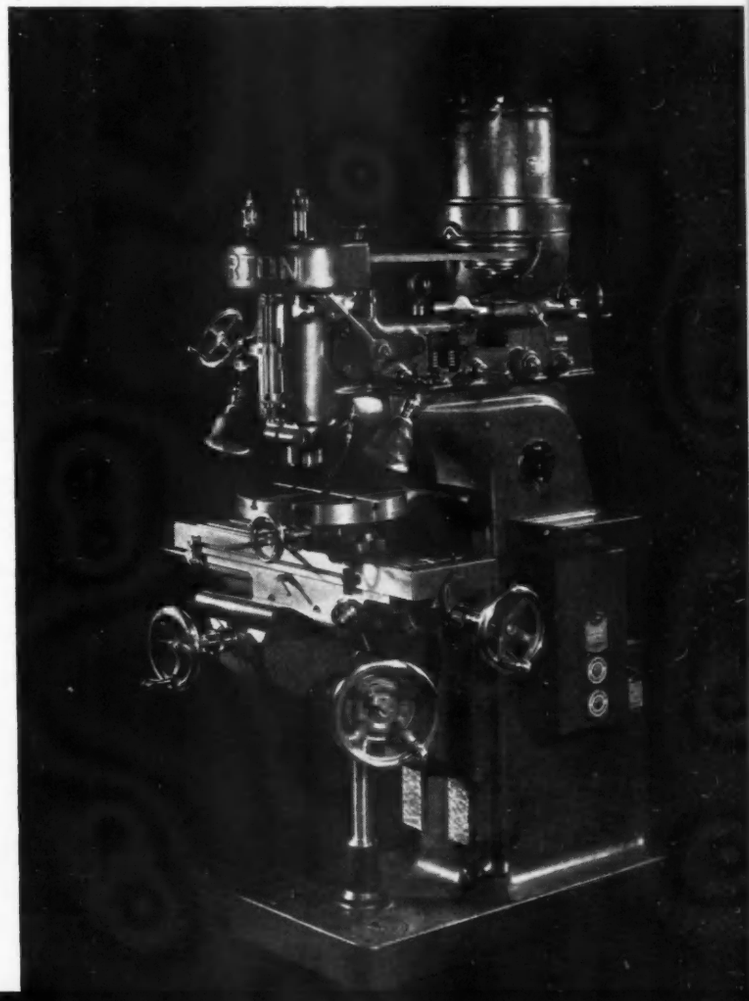
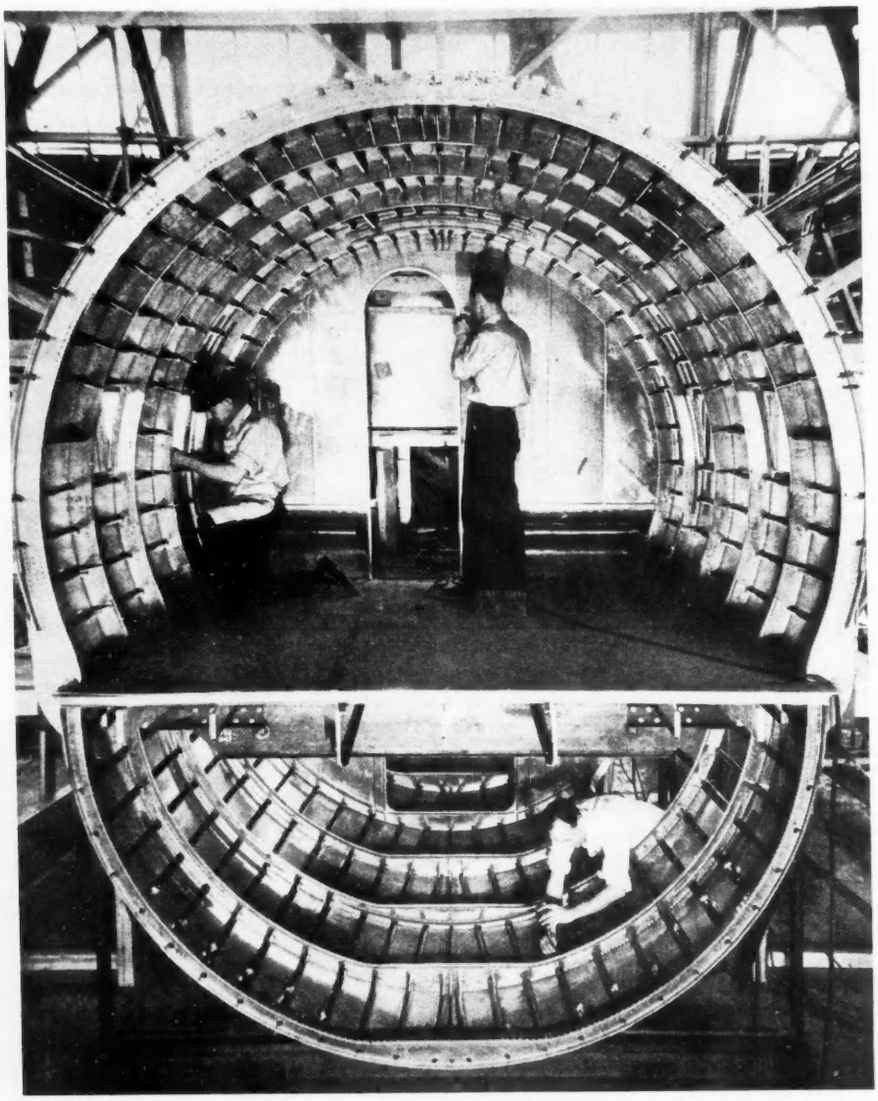
8 ADVANTAGES admirably suited to Aircraft Production

Gorton Super Speed Vertical Milling Machines are designed for high precision, such as is required for Aircraft production. The 8 features above are particularly advantageous to aircraft production—and, most important, an extremely smooth "aircraft finish" comparable to grinding is given to work by the Gorton Machine's fast running cutter. Versatility, too, is advantageous —witness the action close-up above, showing a Gorton No. 8½-D Super Speed Vertical Milling Machine (also at right) applied to a profiling operation. Note that the roller on the tool shank is guided by the holes in the master plate clamped on top of the connecting rod. This operation was photographed at the Wright Aeronautical Plant at Paterson, N. J. Write for bulletin and complete information.



GEORGE GORTON MACHINE CO.
1120 13TH STREET
RACINE, WISCONSIN



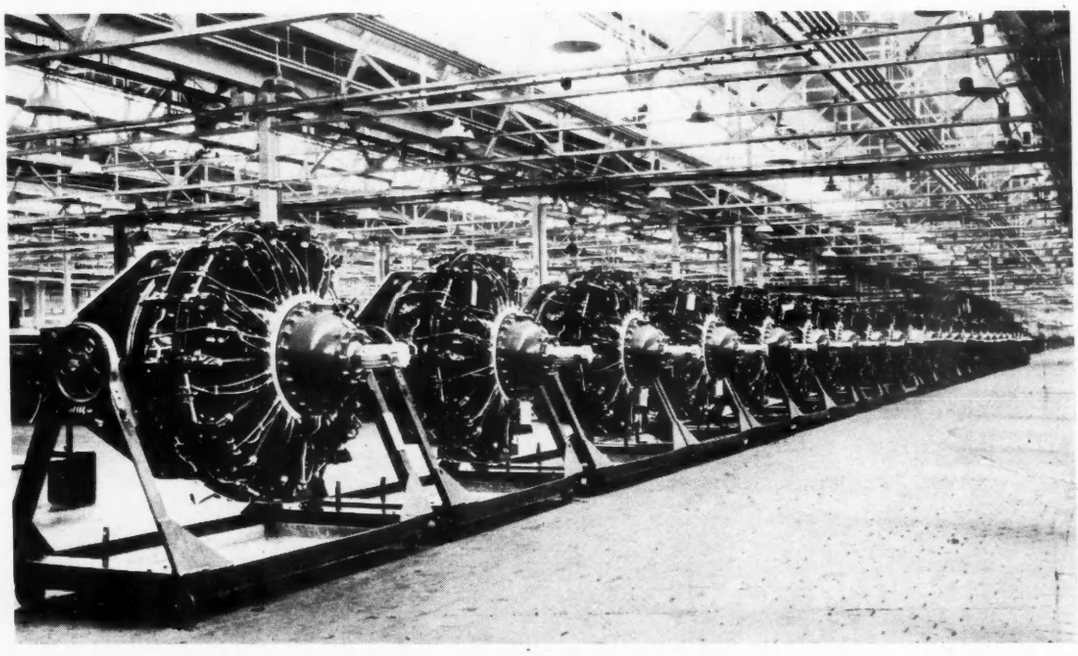
Acme Photo

A cross-section view of the 75-foot-long fuselage clearly illustrates its design of two eccentric circles intersecting so that the floor joins the points of contact, thus affording above a roomy passenger cabin for as many as 40 persons, and below, a cargo compartment accommodating from 5,200 to 6,000 pounds.

serious problems, some of which appear to be bottlenecks in the national defense program, is becoming more and more difficult to solve.

"Why, in the face of the short 'life expectancy' of fighting craft is it necessary to supply airplane engines with as much endurance as is now being built into these powerplants?" the layman asks. "Why not cut corners?"—in view of the cost of money and time. It seems apparent that an engine of less endurance could be built faster and cheaper than those sturdy enough to roar for 500 hours without overhaul. The aircraft engine engineer points out that the ability of an engine to "take it" without failing under the strenuous conditions of combat is the goal. The 500-hour-between-overhaul engine *can* take it. Furthermore, they think it improbable that inferior engines could be built much faster than the good ones, particularly in view of the fact that they are being tooled up for quality production anyway. Management has kept manufacturing in line with advanced design.

To any motor vehicle production man the number of rivets used in fabricating air-



Here is a lineup of completed airplane engines at the East Hartford plant of Pratt & Whitney Company.

International Photo

DESIGNED FOR AIRCRAFT MANUFACTURERS

E.C. NO. 540 UNIVERSAL

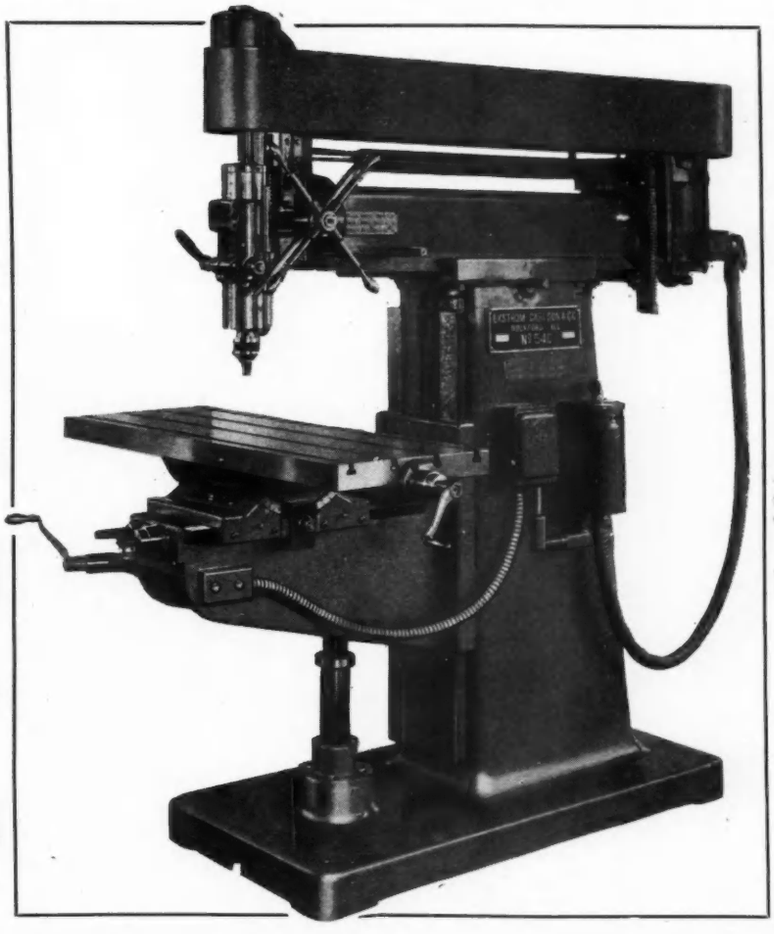
DESIGNED TO PROVIDE SPEED, ACCURACY, AND AMPLE CAPACITY FOR ROUTING, MILLING, DRILLING, GROOVING, GEAR CUTTING, ETC., IN SOFT METALS SUCH AS DURALUMINUM, BRASS, COPPER AND METALS OF SIMILAR QUALITIES.

AIRCRAFT MANUFACTURERS, METAL AND WOOD PATTERNMAKERS, AND OTHER WORKERS IN THE SOFTER TYPE METALS AGREE THAT THE E. C. NO. 540 UNIVERSAL ROUTING, MILLING, AND DRILLING MACHINE FILLS A MUCH NEEDED REQUIREMENT IN EACH OF THESE INDUSTRIES. IT HAS MADE POSSIBLE FASTER PRODUCTION, LOWER COSTS AND BETTER QUALITY OF WORK. ITS ADJUSTMENTS ARE NUMEROUS, ITS CAPACITY IS LARGE, AND BECAUSE OF ITS WIDE RANGE OF POTENTIAL USES, IT HAS BECOME AN INDISPENSABLE MACHINE TO MANY PROGRESSIVE MANUFACTURERS.

MANY OUTSTANDING FEATURES—

- 32" THROAT CLEARANCE.
- 8" TRAVEL OF SPINDLE.
- 8 DIFFERENT SPEEDS.
- 24" VERTICAL ADJUSTMENT OF THE TABLE.
- 30" LONGITUDINAL ADJUSTMENT OF THE TABLE.
- 16" TRANSVERSE ADJUSTMENT OF THE TABLE.
- SPINDLE TILTS 90° IN BOTH DIRECTIONS; TABLE TILTS 30° IN BOTH DIRECTIONS.

WRITE FOR COMPLETE INFORMATION AND PRICE TODAY.



EKSTROM, CARLSON & CO.

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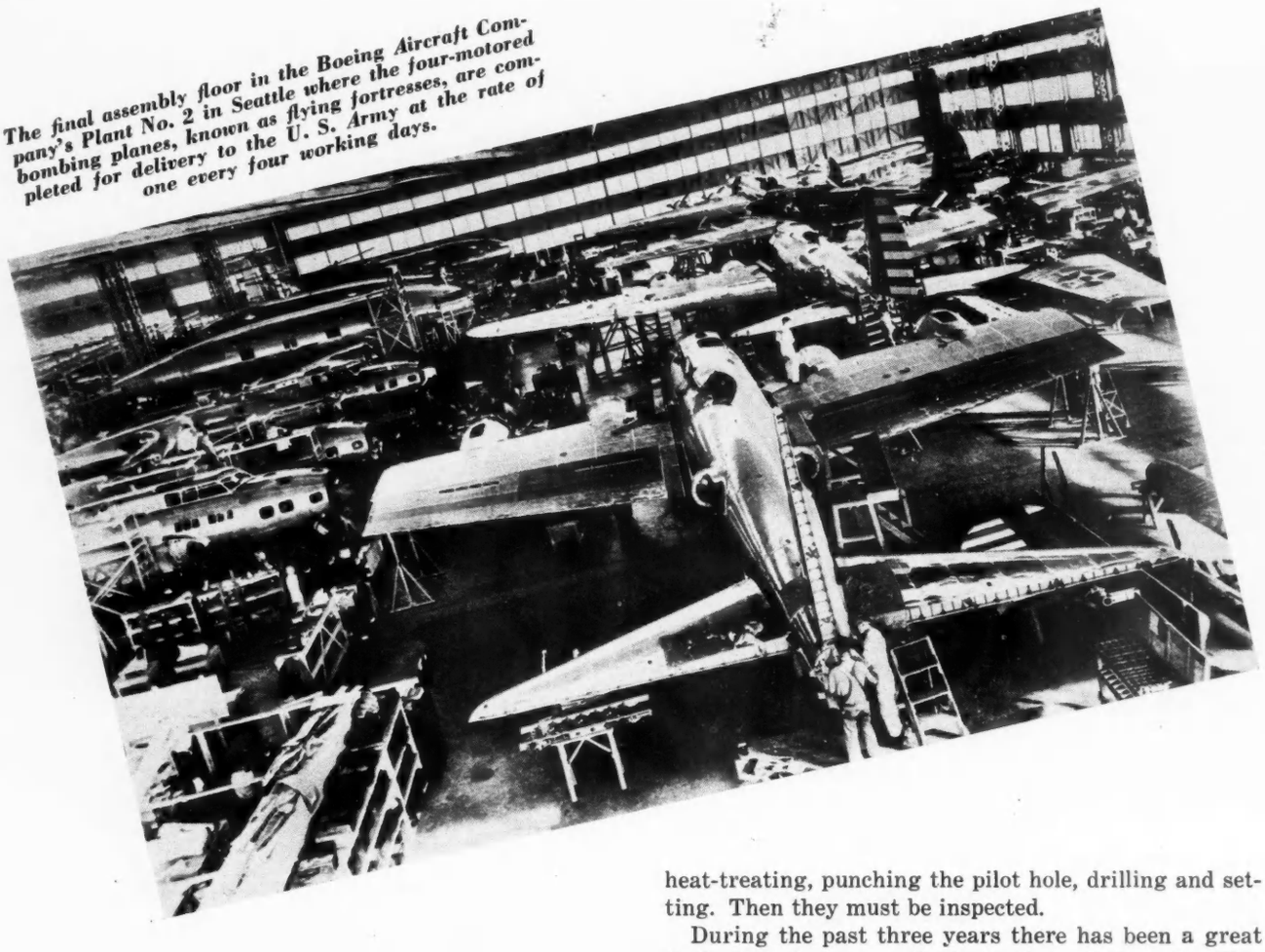


The final assembly floor in the Boeing Aircraft Company's Plant No. 2 in Seattle where the four-motored bombing planes, known as flying fortresses, are completed for delivery to the U. S. Army at the rate of one every four working days.

craft is nothing less than a nightmare. An airliner of 21-day-passenger capacity has more than 500,000 rivets; fighters have around 80,000, and bombers considerably more. The cost of money and time is appalling; rivets cost the aircraft manufacturer from 5½ to 15 cents each, including the price of the rivet itself, heat-treating, punching the pilot hole, drilling and setting. Then they must be inspected.

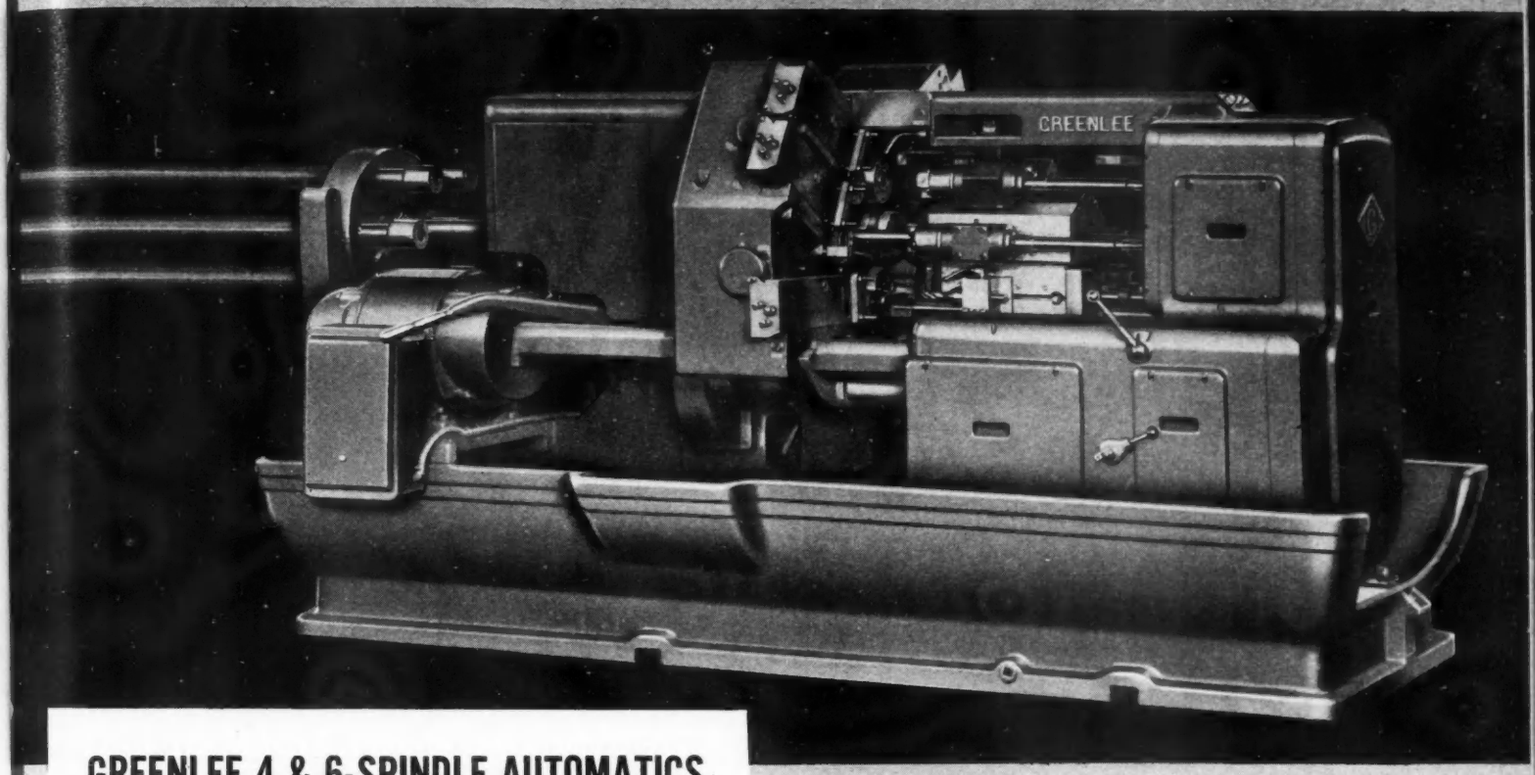
During the past three years there has been a great deal of work done on flush-riveting of aircraft. This reduces the air drag of the riveted aircraft, which requires as much as ten per cent of the engine's power to overcome in some designs. Then, too, the possibilities of reducing the cost of riveting by using flush-rivets has been explored to some extent by several manufacturers. Martin and Douglas are now using flush-riveting with considerable success.

One method employs the rivet itself as a dimpling tool. It is pressed into place after the hole is drilled. This pressing countersinks the rivet, and heads it up on the underside. New tools had to be designed for this work, because such an operation tends to flash the rivet between the sheets, and also to buckle the sheets. Thousands of flush-rivets were microscopically examined, and when none showed any sign

(*Turn to page* 342, *please*)

Girls using microscopes to examine the mirror-like finish of airplane valves at Thompson Products Co., manufacturers of small airplane parts.

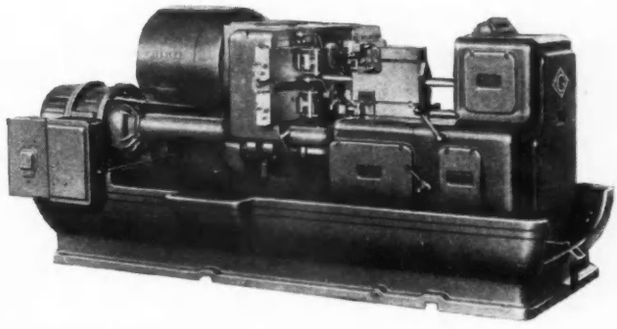
YOU NEED MORE SPEED NOW



GREENLEE 4 & 6-SPINDLE AUTOMATICS CAN HELP YOU STEP UP PRODUCTION

Now, more than ever, with the large-scale defense program and the mobilization of American industry to build our Army, Air Force, and Navy into the strongest and best-equipped in the world, there is a need for speed in production lines . . . a demand for faster and better machines. And Greenlee Automatic Screw Machines are helping many manufacturers meet this demand for extra speed. In manufacturing parts for small motors that are installed on many of the planes turned out for the Army and Navy . . . building fuse parts for shells . . . making parts for automobiles, trucks, and industrial machinery, . . . these are just a few of the jobs on which Greenlee Automatics are saving valuable production time on every set up, and are consistently turning out accurate, high-quality work.

If you are faced with the problem of speeding up production to meet delivery schedules, why not find out how Greenlee Automatics can help you. Write, giving specific data, and we'll gladly submit detailed estimates on the production of your own particular jobs.



GREENLEE 4-Spindle AUTOMATIC SCREW MACHINES

CHECK THESE FEATURES!

- ★ Quick change-over because of compactness, accessibility, and openness.
- ★ All controls are grouped within easy reach of the operator.
- ★ Collets and pushers can be removed without indexing the head.
- ★ Six independent, forged steel cross slides are actuated by standard, interchangeable cams.
- ★ End-working slide makes full stroke each cycle, approaches work fast, and shifts smoothly. Method of feed eliminates all cams and provides quick adjustments.

GREENLEE BROS. & CO., Rockford, Illinois, U. S. A.

MULTIPLE-SPINDLE DRILLING, BORING, AND TAPPING MACHINES
AUTOMATIC SCREW MACHINES • SPECIAL MACHINERY

High Production and Accuracy For National Defense Programs

● **Manufacturing Parts for Airplanes, Cars, Trucks, Tractors and Ordnance—Engines of all Types—Propellers, Landing Gear—Structural Parts—Transmissions, Axles—Shells, Fuses, Gun Mechanisms—and Other Requirements**

Sundstrand Rigidmils

Sundstrand Rigidmils are outstanding producers on a wide variety of milling operations for airplanes, automobiles and other manufacturing; ideal for the urgent needs of National Defense.

Precision-built, with unique Sundstrand features and advantages, Rigidmils provide unexcelled cutting efficiency, speed, accuracy, fine finish and economy; are highly effective on either small-lot or mass production. Standard Rigidmils in several models accommodate all usual milling operations in production departments. Semi-standard and special Rigidmils are available for contour milling of propeller blades or other forms, circular forming, extra long work, multiple operations, and the like.

Get maximum output by specifying Rigidmils for modernization or plant expansion. Save time and money—use Sundstrand Engineered Production Service

Standard Rigidmils

Illustrated bulletins completely describe No. 00, No. 0, No. 1 and No. 33 Standard Rigidmils; give cycle diagrams and specifications; indicate unique advantages that promote faster accurate milling. Write, today, for your copies. Ask for Bulletins 440, 282, 283 and 550.

Other Rigidmils include vertical-spindle, multiple-spindle and traveling-head types; semi-standard and special machines for every milling requirement. Information on request.

Sundstrand Automatic Stub Lathes

Powerful, durable, notably accurate and productive; Sundstrand Automatic Stub Lathes prove especially valuable for turning and facing work like propeller hubs, pistons, cylinder sleeves, bushings, pump bodies, rotors, gear blanks, cam shafts.

Automatic Stub Lathes have an extensive range of speeds and feeds; are readily set up for different jobs; give highly efficient operation on long or short runs, on any machinable material. Automatic cycles are quickly established without making cams; include tool relief, high rapid traverse, and a wide variety of tool movements.

Built regularly in three sizes—Models 8, 10 and 12—Automatic Stub Lathes are available with numerous standard and semi-standard tooling arrangements; also in special types for unusually complex operations. Use Sundstrand Automatic Stub Lathes to speed production, cut costs.

Models 8, 10 and 12 Automatic Stub Lathes

Booklet at right tells all about Models 8, 10 and 12 Sundstrand Automatic Stub Lathes. Shows clearly with pictures, diagrams and specifications just why Automatic Stub Lathes are so accurate, productive, durable, economical; so readily used on many different operations. Brief, easy to read, interesting. Write, now, for your copy of Bulletin 391.

● Let Sundstrand Engineered Production Service speed up preparations for Preparedness. Specific recommendations and reliable quotations on your milling or lathe operations will be supplied promptly, without obligation, upon receipt of job data.

Sundstrand Machine Tool Co.
2527 Eleventh Street, Rockford, Illinois, U. S. A.

SUNDSTRAND MACHINE TOOL CO. · ROCKFORD, ILLINOIS, U.S.A. ·

RIGIDMILS-STUB LATHES

Tool Grinders - Drilling & Centering Machines
Hydraulic Operating Equipment - Special Machinery

WHERE "GOOD ENOUGH" WON'T DO

There are no "unimportant" parts in an airplane engine. Efficiency and dependability demand perfect performance all along the line. Consequently the only standard for selecting materials should be ability to meet the requirements.

Nickel-Chromium-Molybdenum and Nickel-Molybdenum oil hardening steels are being chosen for many engine parts such as crank shafts, pins and accessory gears because of their demonstrated capacity for doing their jobs. Not only do they develop the necessary strength and toughness, but also the requisite hardness, and they machine in the fully heat treated condition.

Thus they give the engine manufacturer confidence in the performance of the parts and help keep his production costs within reasonable limits.

Complete technical data about the various Molybdenum steels will be found in our book, "Molybdenum in Steel". This book will be sent free on request to executives and production heads.

PRODUCERS OF MOLYBDENUM BRIQUETTES, FERRO-MOLYBDENUM, AND CALCIUM MOLYBDATE

Climax Molybdenum Company
500 Fifth Avenue, New York City

MOLY

of rivet fractures or cracks in the sheets, the improved technique was put into practice. Not, however, until special machinery had been built. Then government approval was secured for this type of fabrication for Army and Navy aircraft.

In the meantime, welding and stamping experts are/working on even faster methods of putting airplanes together. Perhaps some genius will find a way to hemstitch or sew sub-assemblies together, as was done in some of the fabrication of the Navy's ZR-1 dirigible.

The general public has been hearing and talking a good deal about the many bottlenecks in aircraft production. "Bottleneck" is not easy to define. There are about 35,000 parts in air-cooled engines. The new Allison liquid-cooled engine is said to have some 60,000 parts. A large number of the aircraft required for Government defense will be powered by two or more of these engines. The airplane itself has thousands of parts. Each instrument is a complicated device. Broadly speaking, each of these parts will constitute a bottleneck if they cannot be produced in sufficient quantities, to close enough tolerances, and in time for assembly. This is the measure of the purely mechanical problem faced by the industry in producing unprecedented numbers of aircraft for national defense.

The humble sparkplug, for example, is causing many sleepless nights these days. It has been said on good authority that between 40 and 60 per cent of the interruptions on the scheduled American airlines due to mechanical reasons is caused by engine ignition troubles. These include sparkplugs, magnetos and their mountings, and the current distribution system. Most of this trouble is due directly to sparkplug failures.

During the last World War American aircraft engines were using for the most part porcelain-insulated plugs. But even the relatively low-powered early air-cooled engines, with their violent and rapid temperature changes, cracked the insulators. This caused preignition and detonation. In spite of improved ceramic insulators, the industry swung to mical insulators. But the inherent limitations of mica appears to have stimulated further work in ceramic and manufacturing research in an effort to solve this grave trouble which faces aircraft engine manufacturers. Experts employed by the engine builders are working with sparkplug engineers employed by the plug makers, and work is being done also by General Electric, the du Pont interests, and the Corning Glass scientists to bring the sparkplug up to higher levels of performance.

There are more than 30 sparkplug makers in the United States, and the public may be assured that everything possible is being done to eliminate this bottleneck in national defense.

Fuel injection developments are underway on a wide front. This method of feeding an engine would permit the use of

(*Turn to page* 413, *please*)

Fast, Flexible, Low Cost

PRODUCTION CLEANING with DETREX PROCESSES

Your part in the National Preparedness Program requires "stepped-up" efficiency both on your regular production and on government orders.

Avoid a "bottle-neck" in your cleaning, finishing and inspection departments by consulting Detrex Engineers for approved methods. Follow government specifications in the cleaning of aircraft and automotive engines and parts, propellers, robots, radio equipment, photographic and optical instruments, indicating and control devices, shells and arms, special mechanisms, sheet metal parts, etc.

Detrex Equipment and Materials for: Solvent Degreasing; Alkali, Spirits, and Emulsion Cleaning; Bonderizing, Painting and Baking.

DETROIT REX PRODUCTS COMPANY

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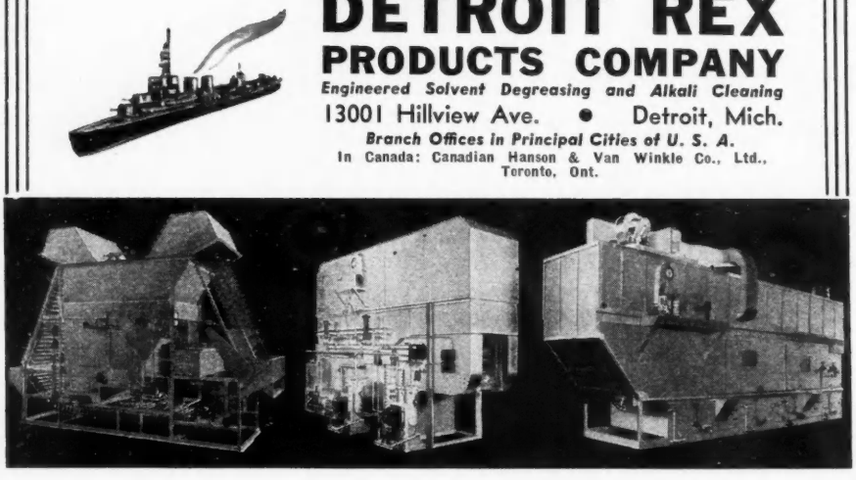
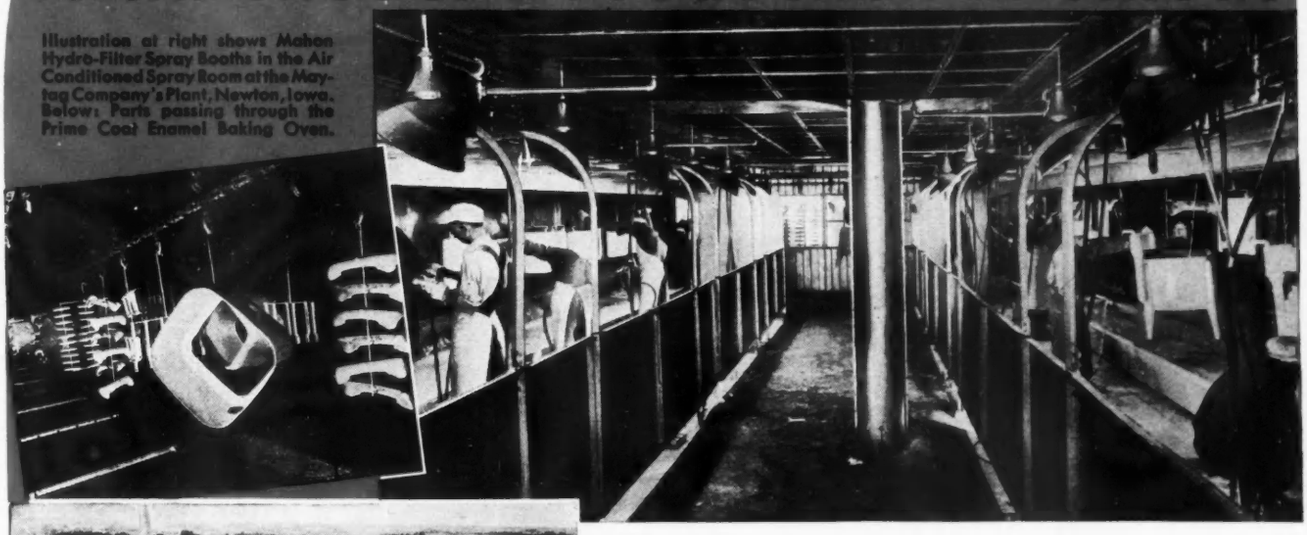


Industrial FINISHING EQUIPMENT *Keeps Pace with Modern Production Methods*

Illustration at right shows Mahon Hydro-Filter Spray Booths in the Air Conditioned Spray Room at the Maytag Company's Plant, Newton, Iowa. Below: Parts passing through the Prime Coat Enamel Baking Oven.



Above: Complete Mahon Finishing System under construction on the roof of the Maytag Company's Plant, Newton, Iowa. Right: Oven Heating Equipment and inside view of all-steel enclosure which houses complete system. Right below: Automatic Temperature and Safety Control Panels which maintain proper temperatures throughout the entire system.

. . . Maytag Installation is Typical of Mahon's Thorough Engineering

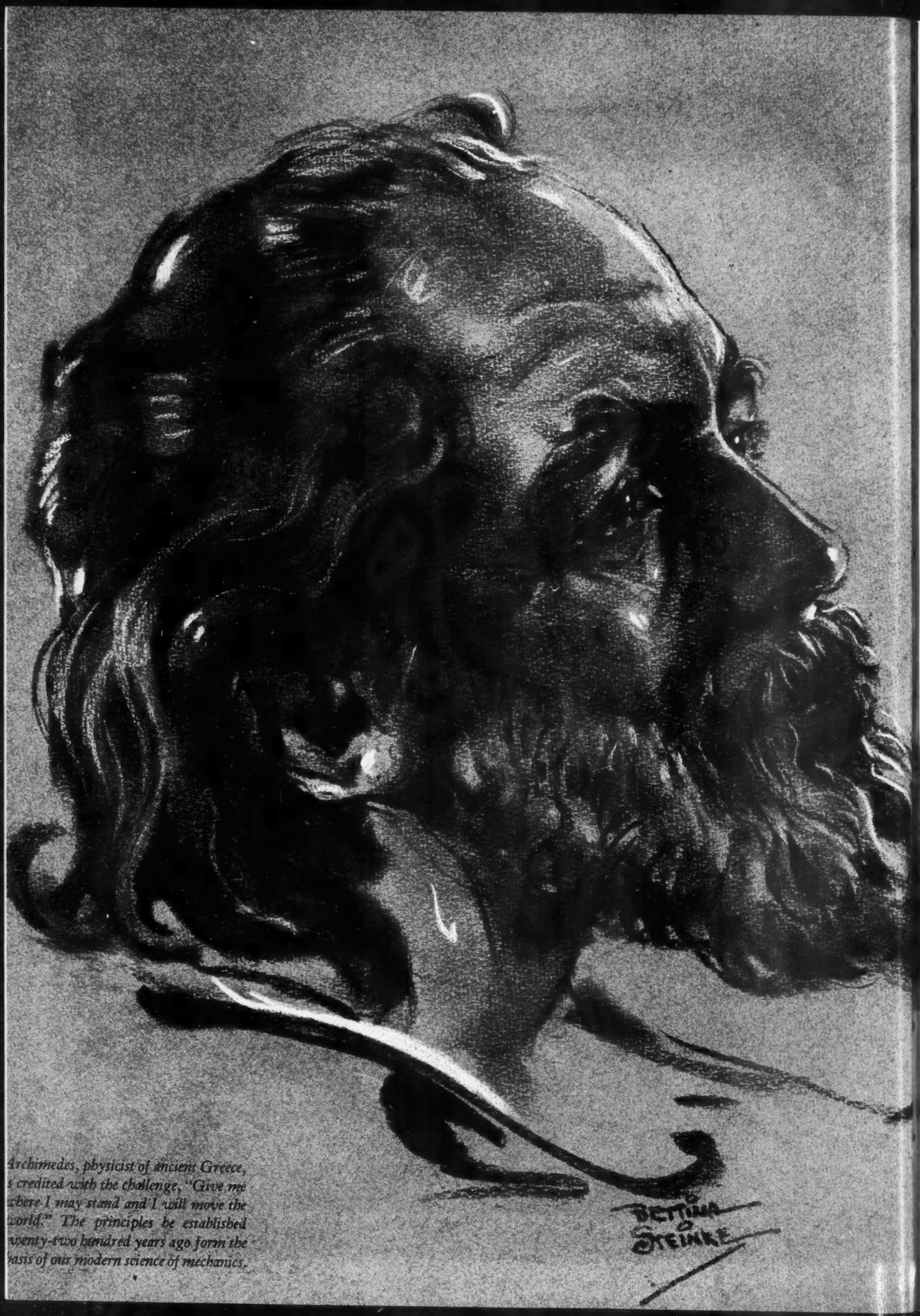
The Complete Mahon Finishing System installed at the Maytag plant, Newton, Iowa, is an excellent example of up-to-the-minute finishing production planning . . . it is unique in that the entire system, with the exception of the Spray Booths, is located on the roof of the plant. All Metal Cleaning, Rinsing, Rust Proofing, Drying and Enamel Baking equipment is housed in an all-steel, firesafe enclosure on the roof, yet each operation in the finishing process is perfectly coordinated to produce the desired results with maximum efficiency and at the lowest possible cost . . . it is typical of Mahon's advanced engineering in this highly specialized field. Mahon engineers, backed by seventeen years of research and practical experience in every industry where finishing is a major production operation, are qualified to do a better engineering job on equipment of this type . . . you can turn your finishing problem over to them with complete confidence. Call in a Mahon engineer today—consultation and study of your requirements will not place you under any obligation.

THE R. C. MAHON COMPANY

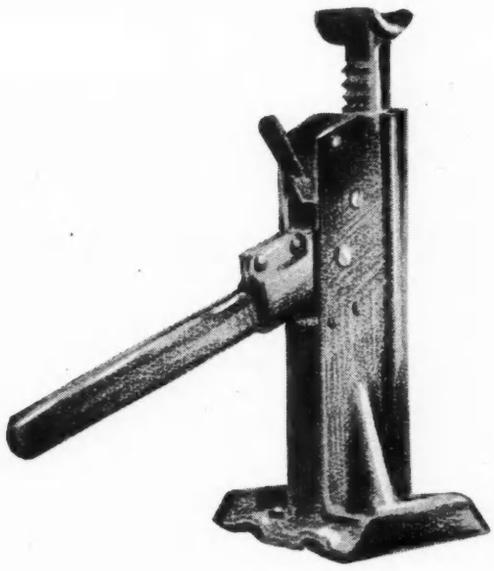
DETROIT - - CHICAGO

Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Hydro-Filter Spray Booths, Ovens of All Types, Filtered Air Supply Units, Hydro-Foam Dust Collectors and many other Units of Special Production Equipment.

MAHON



Archimedes, physicist of ancient Greece, s credited with the challenge, "Give me where I may stand and I will move the world." The principles he established wenty-two hundred years ago form the basis of our modern science of mechanics.

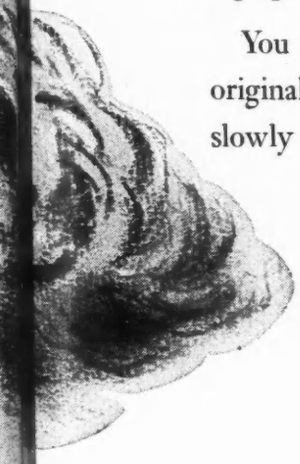


You did move the World, Archimedes!

WHAT'S THAT THING?... It's a "jack"—our simplest application of your lever and fulcrum. With it a slip of a girl can lift several tons.

Jacks are standard equipment with automobiles; in one form or another, they're used extensively in construction,—on farms, and in many industries. They're turned out by the millions—mostly stampings or forgings—formed in dies, assembled and riveted or welded together. The dies are cut in blocks of steel by means of die-sinking machines. Drills, lathes, millers, shapers, grinders—all of these may have a part in the manufacturing operation, either directly or in the *background*, building machines that build machines.

You were right, Mr. Archimedes, 'way back in the third century B.C. Your sound original work in the science of mechanics laid a broad foundation upon which man has slowly built an amazing civilization.



IN THE BACKGROUND of modern industry, you will find Pratt & Whitney machine tools, small tools and gages. Through accuracy, Pratt & Whitney keyword since 1860, production costs are lowered ...new products are developed... new industries arise... new jobs are created. Pratt & Whitney accuracy makes rare luxuries common. Man moves to ever-improving comfort, economy, convenience, health, safety... across the background of Pratt & Whitney accuracy.

PRATT & WHITNEY

Division Niles-Bement-Pond Company

West Hartford, Connecticut, U.S.A.

BELL "AIRACOBRA"

"P-39" PURSUIT PLANE

is equipped with

"NORMA-HOFFMANN" PRECISION BEARINGS

This recent development in military aircraft by the Bell Aircraft Corp., Buffalo, N. Y., with a maximum speed approaching 400 M.P.H., is powered with an Allison 12-cylinder V-Type engine, built by Allison Engineering Co., Indianapolis, Ind.

In keeping with the rigid requirements for speed-ability and dependability fixed by the service for which this plane is intended, its power plant is equipped with NORMA-HOFFMANN PRECISION BEARINGS in the engine proper, in the reduction gear, and on the propeller drive shaft.

"Where the bearings must not fail"—on land, at sea, or in the air—NORMA-HOFFMANN PRECISION BEARINGS, on their record of performance, are the choice of engineers and designers of aircraft and aircraft equipment.

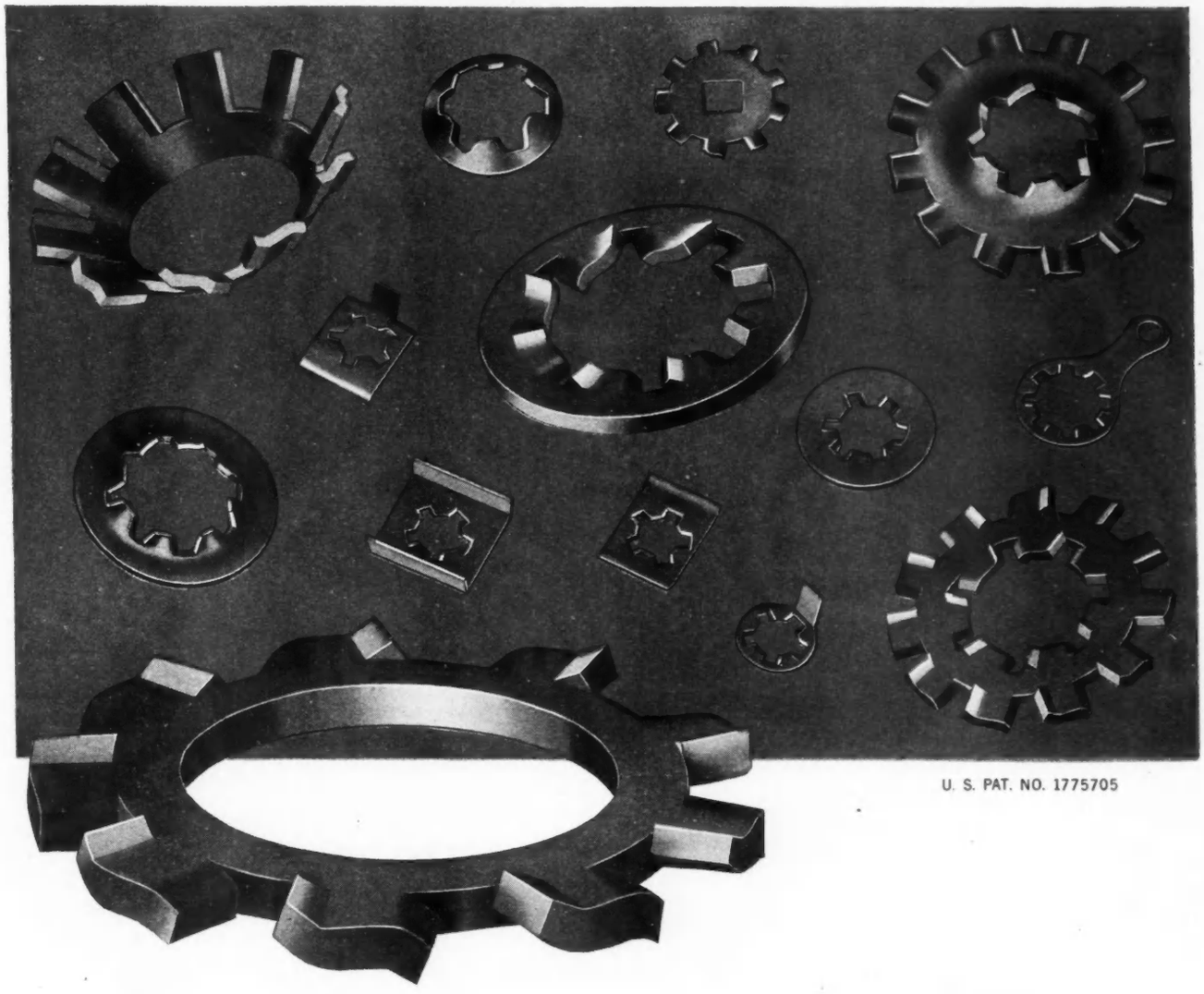
IDENTIFIED with the aircraft industry from its earliest days, NORMA-HOFFMANN pioneered many of the important bearing types now standard in aviation practice. Today, practically every representative American builder of airplanes—whether for commercial, private, or military purposes—uses NORMA-HOFFMANN PRECISION BEARINGS.

In the plane itself, they are found at vital points in the control system. Engine builders employ them in engines, superchargers, reduction gears, and engine accessories. In the instrument equipment, where accuracy and friction-free operation are so essential, NORMA-HOFFMANNS are used by most of the leading instrument manufacturers. Aerial cameras, radio equipment, and landing field equipment, in most cases embody NORMA-HOFFMANN PRECISION BEARINGS.

There is a NORMA-HOFFMANN PRECISION BEARING for practically every aviation requirement—108 distinct series and over 3000 catalogued sizes. Let our engineers work with you. Write for the Catalog.

NORMA-HOFFMANN
BEARINGS CORP'N.
STAMFORD CONN., U. S. A.

STOP YOUR BOLTS, NUTS AND SCREWS FROM LOOSENING *with* EVERLOCK WASHERS



U. S. PAT. NO. 1775705

Washer Tongue Detail

YOU can avoid the costly annoyance of loosened parts by using EVERLOCK WASHERS in your assemblies . . . The powerful spring tension of every EVERLOCK WASHER tongue coupled with the bite of its teeth, does the job more thoroughly than other types of fasteners . . . Pictured is an enlarged EVERLOCK tongue and a few of the different types that are used by the millions on a vast variety of products . . . Service calls due to loosened nuts, bolts and screws on equipment where EVERLOCK WASHERS are used, is unknown . . . There's an EVERLOCK WASHER of the correct type and size for every purpose.

Immediate Deliveries

OFTEN OTHER WASHERS HAVE BEEN TRIED, NOW EVERLOCKS ARE SPECIFIED

PRINTED IN U.S.A.

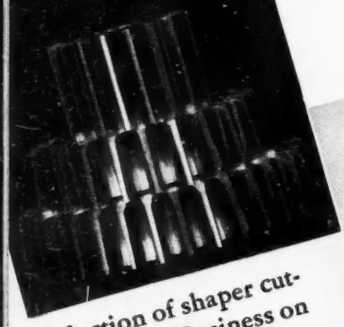
THOMPSON-BREMER & CO. 1640 W. HUBBARD ST., CHICAGO, ILL.

1915

When Michigan Tool Co. first started. At extreme left is Carl Halborg, now Colonial Broach Co. President. At extreme right is Thor Olson, now V. P. of Ex-Cell-O. Next to Olson is Otto Lundell, late President of Michigan Tool. Rear right is Robert Anderson, late Treasurer of the Company.

Michigan Tool Company organized to produce cutting tools. Its first plant is on the third floor of a building on Detroit's Brush Street.

1920



Production of shaper cutters is added. Business on gear cutting tools particularly develops to such an extent that larger quarters are necessary.

1921

Michigan Tool Co. erects its own plant on Jos. Campau.

1922

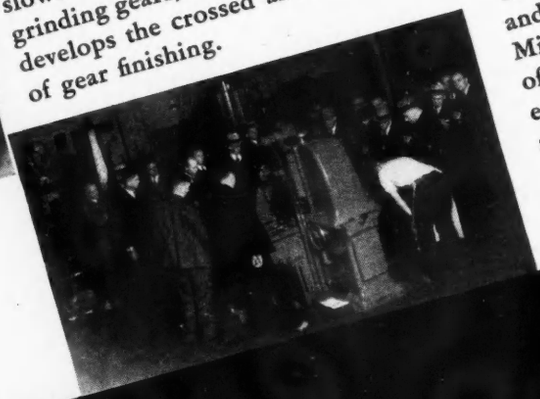
Michigan Tool Co. now enters the field of producing ground form finishing hobs. Develops line of gear and hob checking fixtures for greater accuracy.

1924

The plant is now too small and a second floor is added.

1927

Recognizing the inadequacies, slowness, and relative high cost of grinding gears, Michigan Tool Co. develops the crossed axis method of gear finishing.

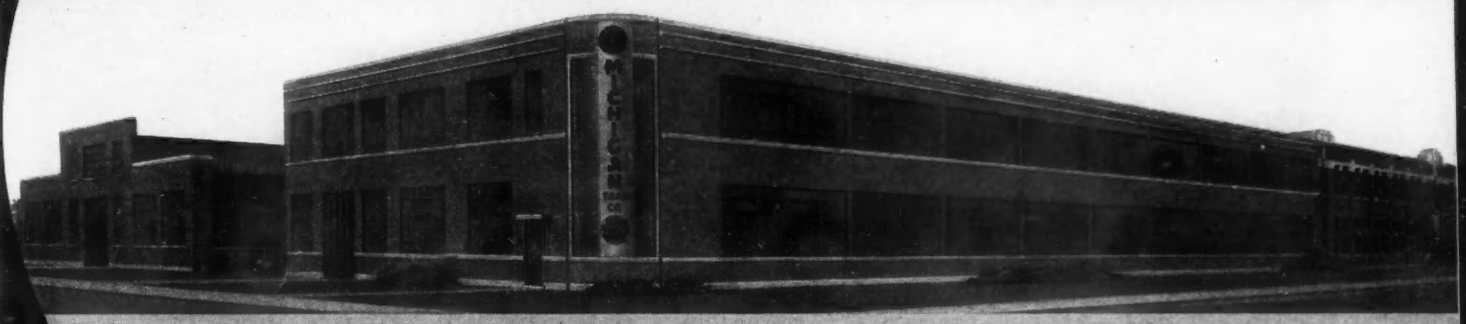


1930

There is immediate acceptance and demand for this equipment. Michigan Tool Co. adds a line of gear checking and lapping equipment. The plant is now too small and a new plant is built on 6-Mile Road.

TWENTY-FIVE YEARS . . BETTER GEARS

. . . *so that in 1940*



Cone-Drive production has now grown to such a point—while machinery and tool sales continue to mount—that it has become necessary to expand for the fifth time.

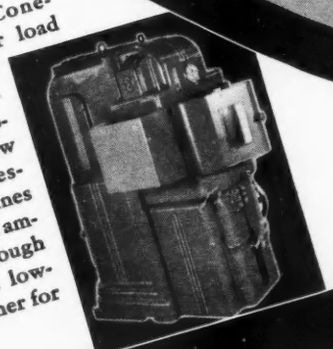
Thus a quarter-century ends and a new one begins—with new machines to further cut gear costs and speed production—new equipment for mass production of Cone-Drive, new developments in the production of finer tools at lower cost.

MICHIGAN TOOL COMPANY

7171 EAST McNICHOLS, DETROIT, U. S. A.

1932

Michigan Tool Company starts development of a new form of gearing: "Cone-drive" of far greater load carrying capacity. This gearing requires the development of entirely new machining processes. Machinery lines have been improved and amplified particularly through the development of a low-cost Rotary gear finisher for "job-lots".



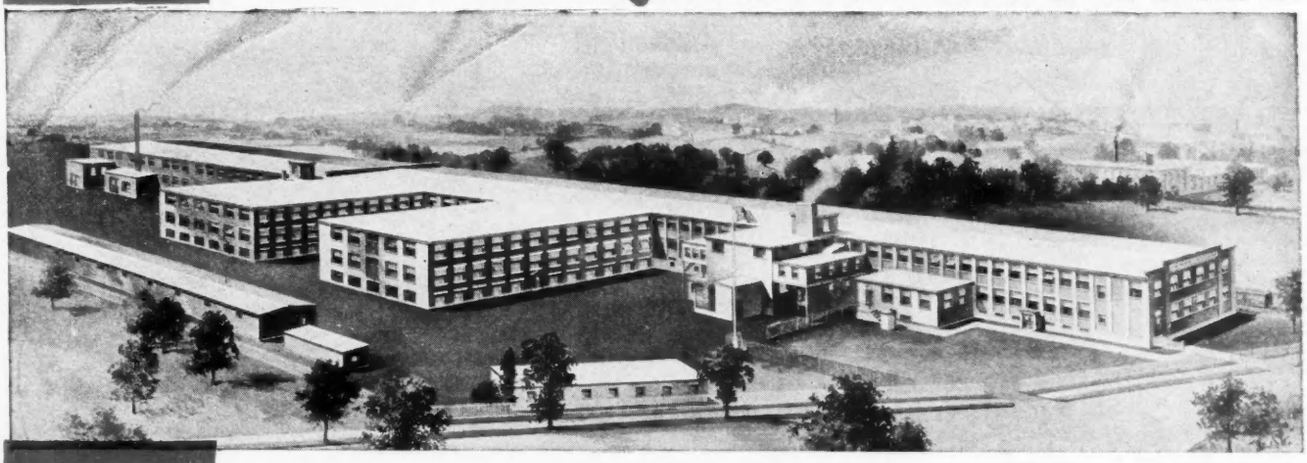
1936

Again the plant is too small and a large wing is added in which production of machinery is concentrated.

1939

Cone-Drive production has developed rapidly with completion of equipment development.

SERVICE-QUALITY-ECONOMY



HOLTITE PHILLIPS RECESSED HEAD SCREWS

Dependable HOLTITE *Fastenings*

COMPLETE STOCKS — PEAK PRODUCTION — DELIVERIES ON TIME!

With the latest precision machinery, modern production methods, long service workers supervised by a skilled engineering staff, and every scientific laboratory facility, the spacious Continental Screw Company plant of over 3 acres floor space is amply equipped to economically produce quality fastenings, and render the accelerated service required to meet present day demands.

Within our own plant we have a fully equipped steel processing mill which enables us to complete the important first stage of fabrication independent of all outside sources.

The HOLTITE line comprises a wide range of time-tested, precision-made fastening units. It has been our privilege to assist thousands of manufacturers in the design and production of Special parts and fastenings precisely suited to their individual needs. Send samples or specifications of your requirements for quotations.

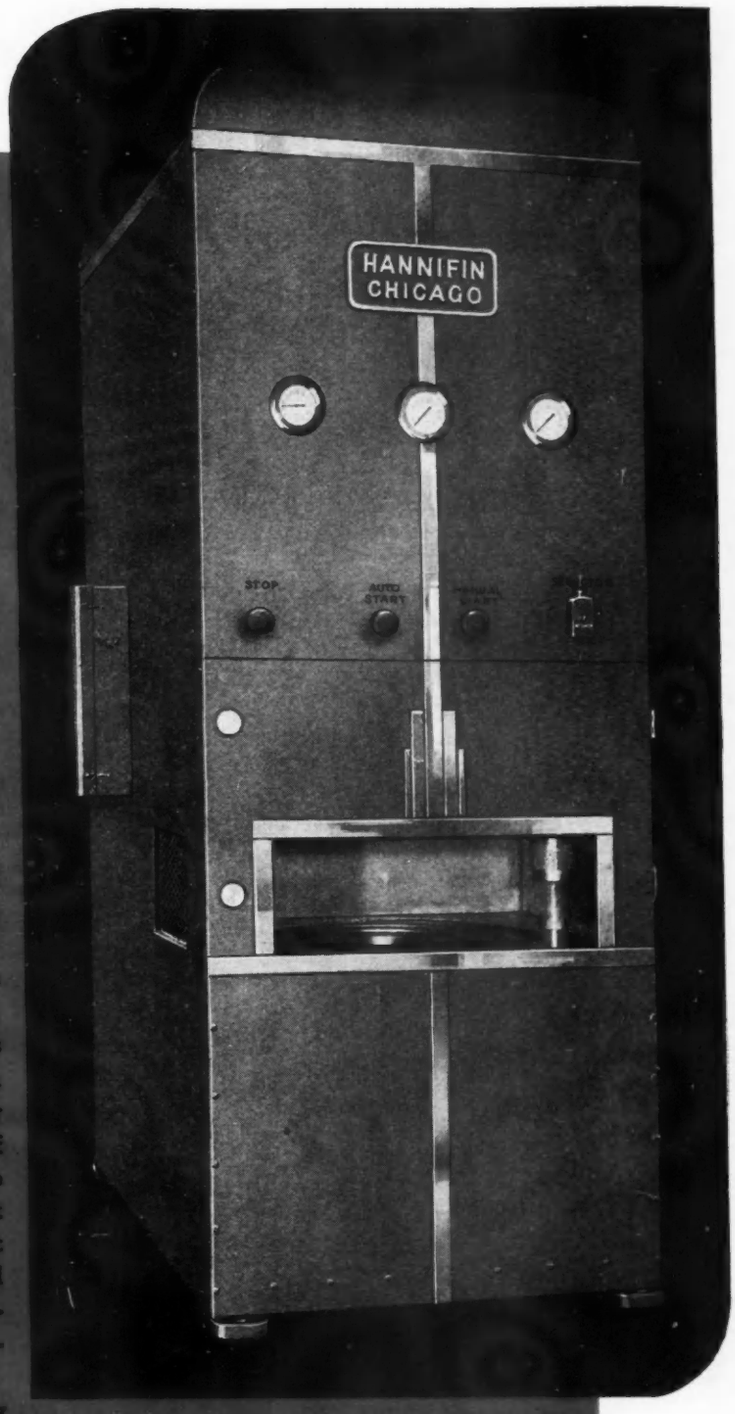
Specify HOLTITE products on your next order — check their strength, accuracy, uniformity and ease of application — you'll find them the most economical fastenings for smooth, uninterrupted production.

CONTINENTAL SCREW CO

New Bedford, Mass. . . Warehouses at Detroit & Chattanooga

CENTRIFUGAL QUENCHING

Uniform quenching without distortion of heat-treated circular parts accomplished in seconds instead of minutes.

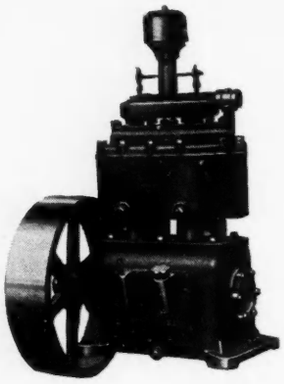


Greatly accelerated quenching of heat-treated circular parts—in gears, sprockets, cams, and bearing races, and other round pieces—is accomplished under controlled conditions by the Hannifin Quenching Machine. Operation is automatically controlled with a definite, rapid time cycle 4 to 6 times as fast as other methods of quenching. Distortion is avoided by the centrifugal quenching—the application of a large volume of quenching fluid at uniform temperature to the entire circumference of the part simultaneously. Hannifin methods not only greatly increase production and avoid distortion in the quenching operation, but often cut subsequent finish-machining work.

If you heat treat circular parts of any kind, find out about centrifugal quenching advantages. Write for Bulletin 55, or consult Hannifin engineers for specific recommendations.

HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue · Chicago, Illinois

HANNIFIN QUENCHING MACHINE

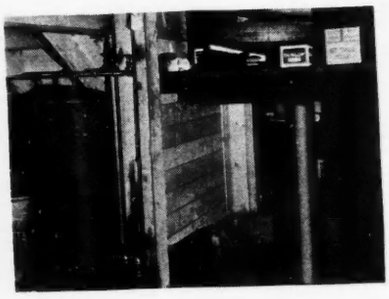


Lower Your Costs for AIR with CURTIS Model "C" Compressors

(Timken Bearing Equipped)

Here's a great compressor value—backed by Curtis' 86 years of successful engineering and manufacturing experience. The advanced engineering and built-in quality of Curtis Model "C" Air Compressors offer you:

- Maximum capacity per dollar of first cost.
- Highest volumetric and mechanical efficiency.
- Maximum actual air delivery per unit of power input.
- Lowest Maintenance expense and oil consumption.
- Capacities up to 360 cfm.



Reduce Handling Costs with Curtis Hydraulic Lifting Cylinders

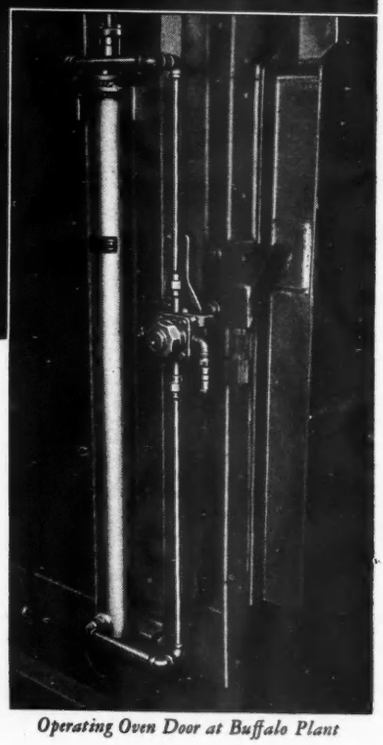
This is just one example of how Curtis Hydraulic Lifting Cylinders are solving a wide variety of lifting and lowering problems in hundreds of industries. They are stepping up production and cutting handling costs in plants throughout the country.

They offer a simple, dependable and safe hydraulic device for raising or lowering materials quickly, accurately and economically. Adaptable to your special purposes, Curtis Hydraulic Cylinders offer:

- Low first cost.
- Inexpensive operation and maintenance.
- Easy installation.
- Your choice of using shop air lines or electric current.
- Safely oil locked at all heights — capacities to 17 tons.

Write for details of specific applications and complete information.

You Can *Step Up* Mass Production with CURTIS Air Cylinders



Operating Oven Door at Buffalo Plant

Used by Curtiss-Wright Corporation at Buffalo and St. Louis Plants

☆ In these days of national emergency, it is more important than ever to keep production continuous, to step up its efficiency and to minimize interruptions for repairs.

Under such conditions, Curtis Air Cylinders give unfailing service because of their rugged construction and simplicity of design—only one moving part. It is often a simple matter to powerize a hand operation with a Curtis Air Cylinder and not only increase your production but lower costs at the same time.

As in the Curtiss-Wright installation illustrated above, Curtis Air Cylinders are ideal for a wide variety of lift, push or pull operations. They are stepping up production and cutting handling costs in hundreds of other industries too.

Installation cost is small and power consumption low, using regular shop air lines. Accurate control is assured and there is no risk of injury from overload or bad atmospheric conditions. Because of their efficiency, negligible maintenance expense and long life, important savings are almost inevitable wherever Curtis Air Hoists and Cylinders can be used.

It will pay you to check your plant to see where Curtis Air Power Cylinders can be applied to increase efficiency. Our new free booklet, "How Air Is Being Used in Your Industry," will give you helpful suggestions. Send for it today.

CURTIS PNEUMATIC MACHINERY COMPANY
1917 Kienlen Avenue, St. Louis, Mo

Please send me booklet "How Air Is Being Used in Your Industry."

Name.....

Firm.....

Street.....

City.....State.....

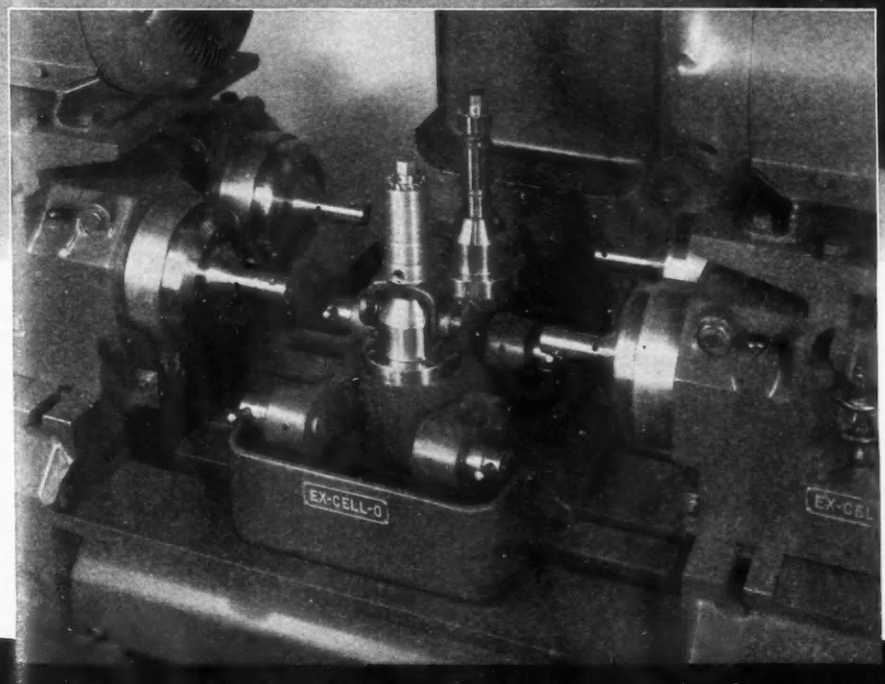
CURTIS

St. Louis • New York • Chicago • San Francisco • Portland

EVER-INCREASING PRODUCTION!
EVER-GREATER PRECISION!

Ex-Cell-O Machines are a Constant Factor in Achieving Progressive Aims of American Industry

Throughout the automobile industry—as in the aircraft, refrigeration, household appliance, agricultural, and many other major industries—Ex-Cell-O Precision Boring Machines find wide application . . . speeding output . . . improving quality . . . reducing expense . . . contributing in a practical way to the progress that is bringing to the American people, products that are constantly performing better, lasting longer, costing less.



● Illustrated is a typical Ex-Cell-O Precision Boring application, one of many automotive parts finished to close limits at a high production rate on an economical basis. Machine: Ex-Cell-O Double End Junior; Part: Universal Joint Knuckle; Operation: Rough bore, finish bore, counterbore; Diameter bored: 1.1873″; Length of cut, 2⅛″; Tolerance: ± .0003″.

EX-CELL-O CORPORATION
1212 Oakman Blvd. Detroit, Mich.

Ex-Cell-O Corporation
1212 Oakman Blvd., Detroit, Mich.

Please send me literature on Ex-Cello-O Precision Boring Machines.

Name _____

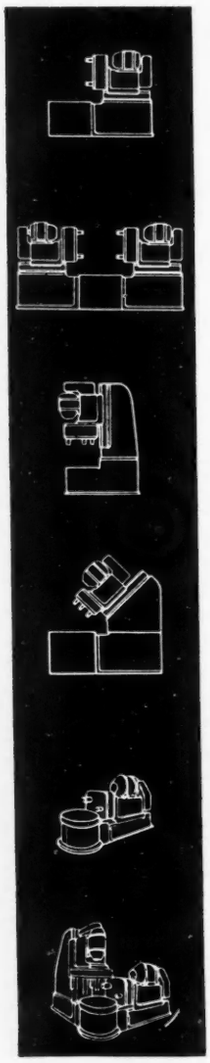
Firm _____

Address _____

EX-CELL-O (XLO) *Precision* **MACHINES AND TOOLS**

In Defense of Your Investment

USE UNIT-TYPE SPECIAL MACHINES FOR DEFENSE TODAY—PRODUCT MACHINING TOMORROW



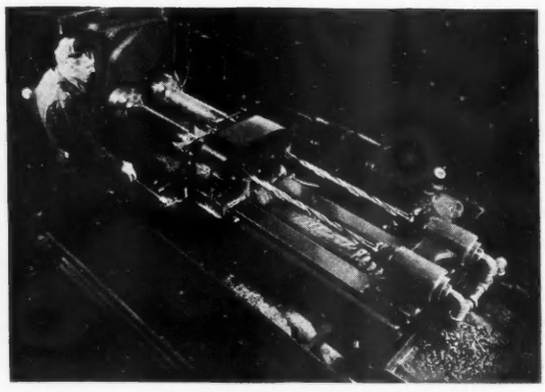
● The truck, tractor, or automobile manufacturer uses many special machine tools in his straight line mass production manufacturing methods. To protect his investment in case of future product design changes, he uses unit-type machine tools. These are assembled from standard feed and drive units. Therefore, by merely changing tooling and fixtures it is often possible to accommodate future changes in part design.

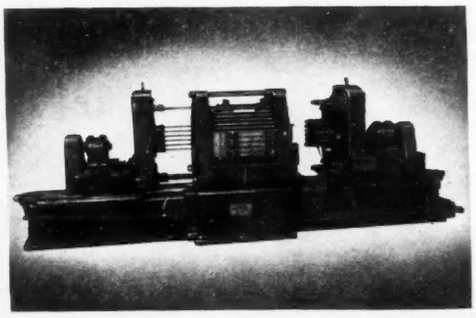
These unit-type special machines will prove a practical investment for your defense contract work. Instead of becoming worthless equipment when finished with defense, they can be converted to your daily product manufacturing. The cost for tool and fixture changes will, in many cases, represent your total investment for a *complete* machine.

Almost any combination is available in these unit-type machines. Some of the simpler arrangements are shown in the sketches to the left. Similar machines as applied to ordnance work are shown on these two pages. Send us part prints for machine recommendations and production estimates . . . all inquiries handled in confidence.

DEEP HOLE DRILLERS

These hydraulic deep hole drillers are furnished in one, two, or four-spindle machines. They are designed to accommodate gun barrels ranging in size from 30 to 50 caliber. Similar machines can be furnished to handle barrels up to 37 m.m. Machines of this type are also readily adapted to crankshaft drilling and boring.





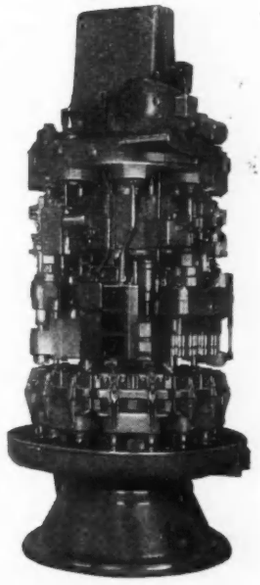
RIFLE BARREL REAMING

Over one hundred rifle barrels are reamed every hour with this one unit-type machine. It accommodates barrels ranging from 22 to 50 caliber. Additional information is available in our Rifle folder . . . write for your copy.

GUN TUBE HONING

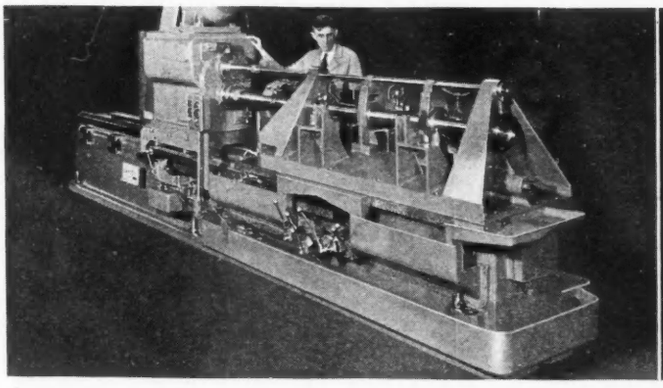
GENERAL PURPOSE BORING AND HONING MACHINE ADAPTABLE TO GUN TUBE HONING

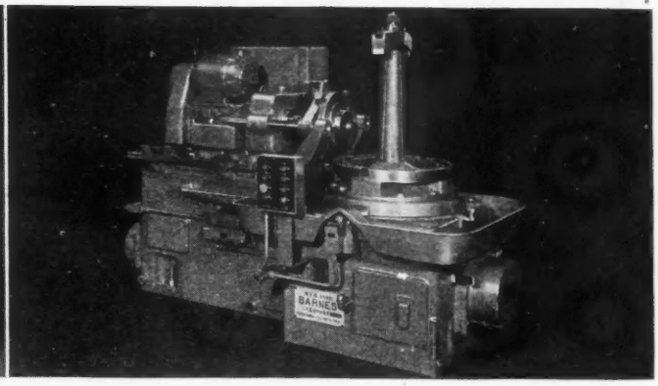
● This general purpose machine proves an excellent investment for plants requiring boring and honing operations on hydraulic and similar cylinders. Its design and versatility makes it an ideal machine for honing gun tubes. One prominent manufacturer uses it for honing 75 m.m. gun tubes—another for honing 37 m.m. gun tubes. When finished with this work, they will have a machine adaptable to a great variety of boring and honing requirements. *Both* boring and honing are available from this one machine. Write for additional information.



BRASS SHELL CASES FOR LIGHT ARTILLERY

This high production machine is capable of producing over 700 brass shell cases per hour. It is in daily use in several automotive plants performing other operations on automobile and tractor parts. Its production possibilities are high. It is easily tooled to accommodate different operations simultaneously. Write for our Center Column Machine folder.

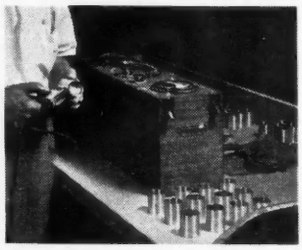


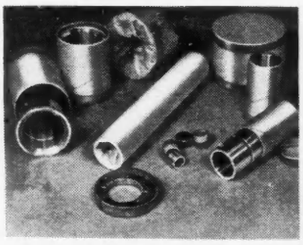


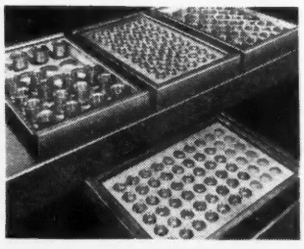
AIRPLANE ENGINES The machine to the left above is a cam and crank boring machine for a straight in line airplane engine. The other unit-type machine is designed to drill four holes in the faces of a radial engine crankcase. These are representative machines from a number built for both radial and straight in line type engines. Additional information is available in our aircraft booklet. Write for your copy.

W. F. AND JOHN BARNES COMPANY • ROCKFORD, ILLINOIS

PRECISION *in* PRODUCTION
OF AIRCRAFT PARTS



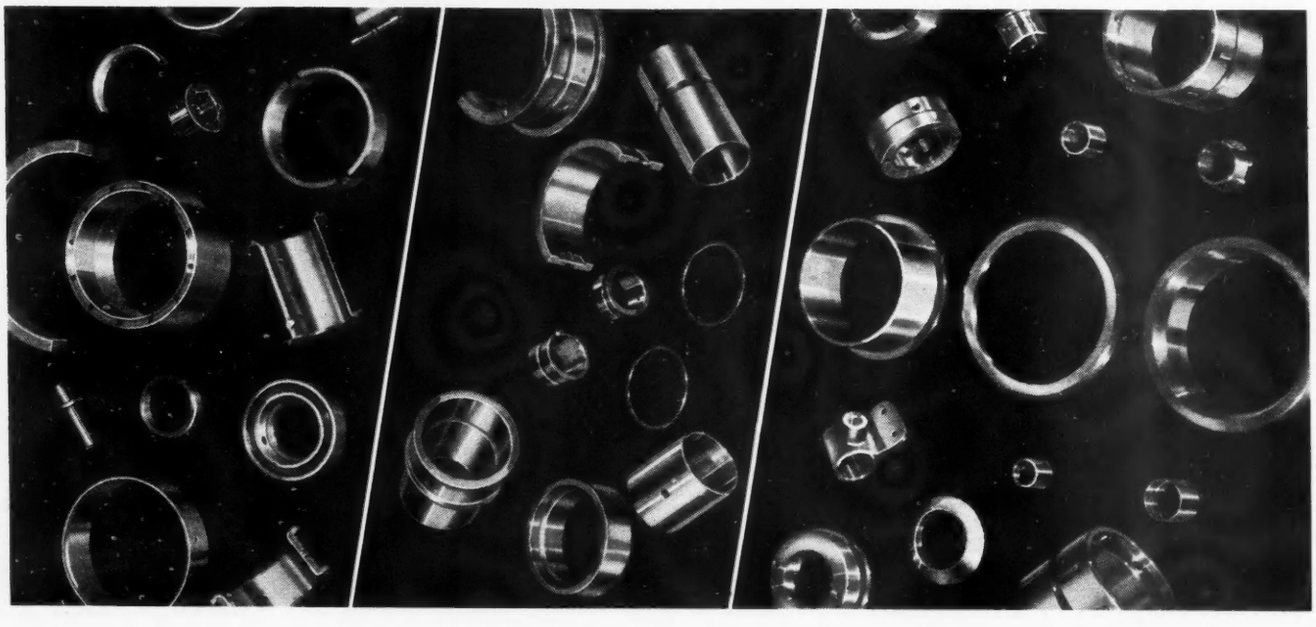


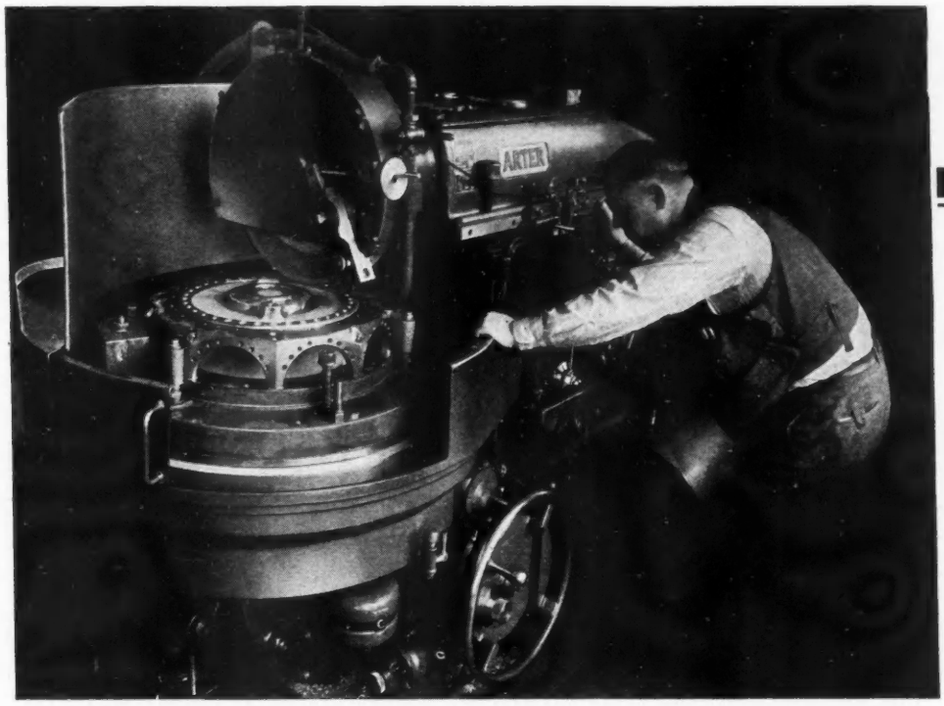


FEDERAL-MOGUL'S exceptional manufacturing facilities and methods of rigid control, inspection and handling assure production of bearings, bushings and a wide variety of other similar aircraft precision parts to the most exacting Government standards.

FEDERAL-MOGUL CORPORATION
11029 Shoemaker Ave.
Detroit, Michigan

FEDERAL Mogul





SPLITTING "TENTHS"

in Aircraft Manufacture . .

At the Wright Aeronautical Corp., Paterson, N. J., an Arter Model B-30" Hydraulic Rotary Surface Grinder finishes crankcase faces of Wright Cyclone engines. The adjacent flange diameter is ground at the same setting, using the side of the wheel.

In every industry—whenever the job requires grinding within a fraction of a "tenth" of perfection—Arter Rotary Surface Grinders produce uniformly high quality work.

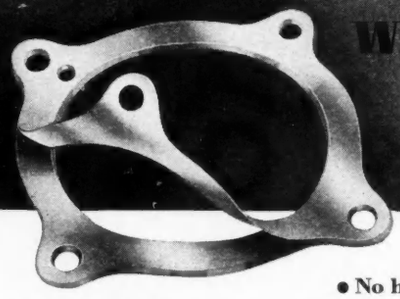
Capacities from 8" to 40"

Write for full details of their precision construction.

» ARTER «

GRINDING MACHINE COMPANY

WORCESTER, MASS.



• No half measures! Adjustments in aircraft assembly—flap control, stabilizer, tail chassis, adjustable-pitch propeller, engine, instruments—*all* must be held to extreme accuracy. • "Without Laminum shims it would be practically impossible to adjust certain assemblies to the close limit required"—this from a top-ranking airplane builder. • Laminum shims are doing the *same* job throughout industry . . . and at the same time speeding precision assembly and bringing down costs. Paper-thin laminations (your choice of .003 or .002 inch, or less, in thickness) are simply *peeled* off the brass shim as needed. As easy as that—in assembly or service adjustments!

Laminum shims are furnished cut to your exact specifications. For maintenance requirements, Laminum sheets or strips are obtainable from leading mill supply houses.

LAMINATED SHIM CO., INC. 51 Union Street, Glenbrook, Connecticut
CLEVELAND DALLAS HOUSTON MILWAUKEE SAN FRANCISCO TULSA

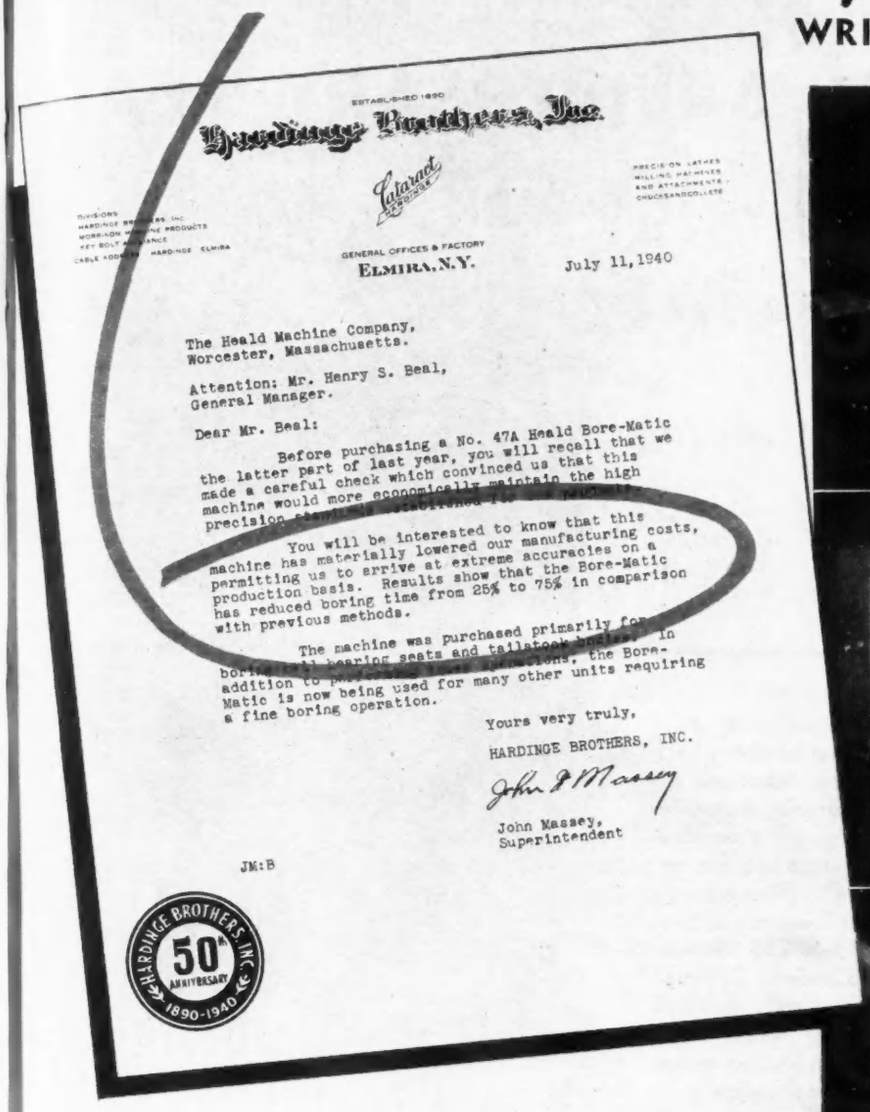
Application Chart FREE . . .
A file folder that illustrates and classifies the many types of laminated shim applications. For handy, practical use. With it a Laminum sample. Write for it.

LAMINUM
TRADE MARK
THE SOLID SHIM THAT *peels* FOR ADJUSTMENT

1147

"Bore-Matic reduces Boring Time 25% to 75%"

WRITE HARDINGE BROTHERS, Inc.



ESTABLISHED 1890

Hardinge Brothers, Inc.

Cataract Brand

PRECISION LATHES
MILLING MACHINES
AND ATTACHMENTS
CHUCKS AND COLLETS

DIVISIONS
HARDINGE BROTHERS, INC.
MORRISON MACHINE PRODUCTS
KEY-BOLT ATTACHMENT
CABLE ADDRESS: HARDINGE ELMIRA

GENERAL OFFICES & FACTORY
ELMIRA, N.Y.

July 11, 1940

The Heald Machine Company,
Worcester, Massachusetts.

Attention: Mr. Henry S. Beal,
General Manager.

Dear Mr. Beal:

Before purchasing a No. 47A Heald Bore-Matic the latter part of last year, you will recall that we made a careful check which convinced us that this machine would more economically maintain the high precision [illegible]

You will be interested to know that this machine has materially lowered our manufacturing costs, permitting us to arrive at extreme accuracies on a production basis. Results show that the Bore-Matic has reduced boring time from 25% to 75% in comparison with previous methods.

The machine was purchased primarily for [illegible] bearing seats and tailstock [illegible] addition to [illegible] operations, the Bore-Matic is now being used for many other units requiring a fine boring operation.

Yours very truly,

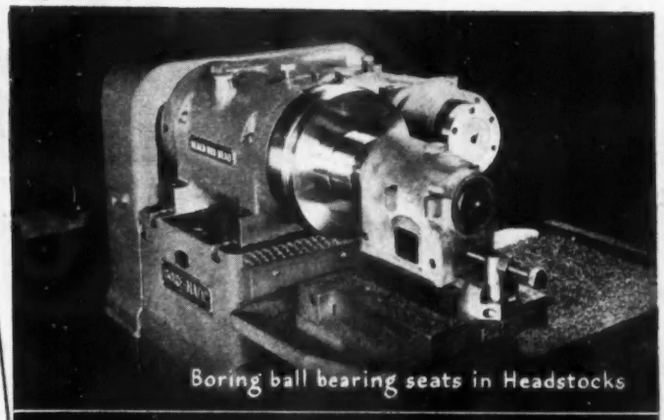
HARDINGE BROTHERS, INC.

John Massey

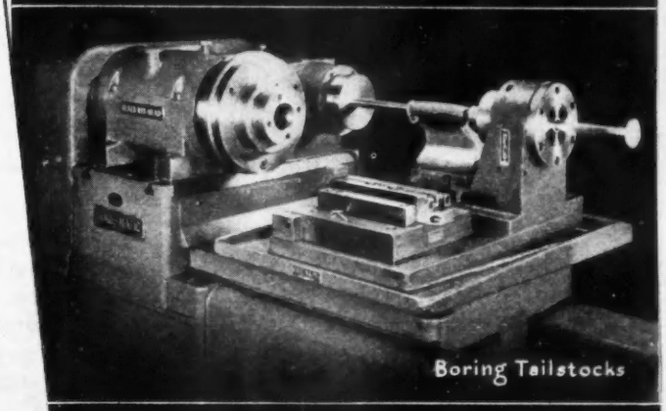
John Massey,
Superintendent

JM:B

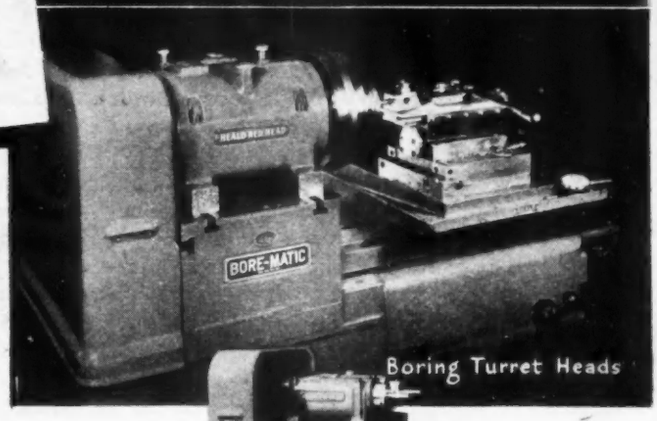
HARDINGE BROTHERS, INC. 50th ANNIVERSARY 1890-1940



Boring ball bearing seats in Headstocks



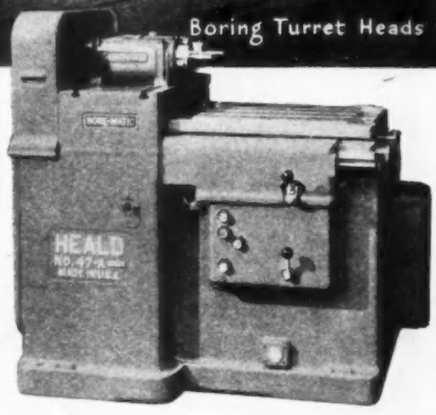
Boring Tailstocks



Boring Turret Heads

"MAINTAINS EXTREME ACCURACY ON PRODUCTION BASIS"

"Extreme accuracy on a production basis is now obtained with a Heald Bore-Matic" write Hardinge Brothers, Inc., manufacturers of fine machine tools. Their Bore-Matic, they add, has materially lowered manufacturing costs, savings ranging up to 75%. This Bore-Matic is used to precision bore headstock bearing seats, tailstock bores, turret heads, as well as many other parts. Results are characterized by very close and uniform accuracy for size, roundness and straightness, essential requirements to meet exacting Hardinge standards but only obtained by previous methods with considerable care and expense. Such results are by no means unusual. Many other manufacturers have installed Bore-Matics with equal success. Their experience has conclusively shown that precision can be produced economically with Heald Bore-Matics.



Borize and Save with BORE-MATICS

The HEALD Machine Company

WORCESTER, MASSACHUSETTS, U. S. A.

25th ANNIVERSARY YEAR

This Silver Jubilee Year brings occasion for retrospection and a review of our growth since the humble birth of our company back in 1915. . . . In the corner of the family tin shop, father and son (the writer) manufactured the first Donaldson Cleaner, a centrifugal type with closed dust receptacle. Within two years our sales had grown to a point necessitating a new location and the employment of 15 men. By 1921 we were building filter type air cleaners as well as the centrifugal type; and our constant emphasis on experimental work brought forth the Donaldson Oil-Washed-Air Cleaner in 1931. . . . Today with a shop force of 230 men operating two shifts, and housed in our own frequently enlarged plant, we feel a tingle of pride in the fact that Donaldson Oil-Washed-Air Cleaners are standard equipment on leading makes of power units for industry, agriculture, and transportation.

Donaldson Cleaners supply complete dust protection for both Diesel and Gasoline Engines, and the work of Donaldson engineers is constantly attuned to the latest trends in motor construction. If you have a dust problem, feel free to call upon us for recommendations. Donaldson Cleaners are individualized to fit each job.

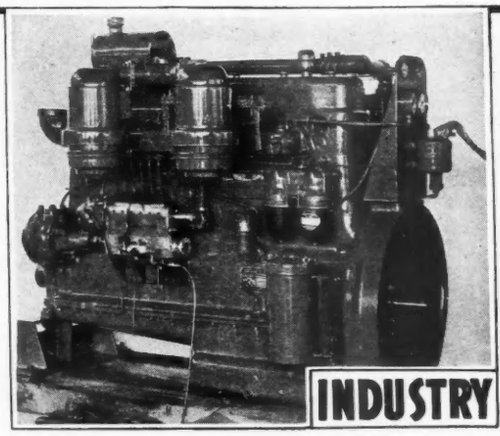
Gratefully we acknowledge the confidence placed in our products during the first 25 years.

Sincerely,

Frank G. Donaldson President

DONALDSON COMPANY, INC.

666 Pelham Blvd.
St. Paul, Minn.



1915

DONALDSON
Oil-Washed-Air
CLEANERS

1940

EFFICIENT AIRCRAFT PARTS PRODUCTION ... WITH MODERN BROWN & SHARPE MACHINES

In expanding your production, obtain equipment which will give the greatest return in productivity and accuracy.
– Specify Brown & Sharpe –

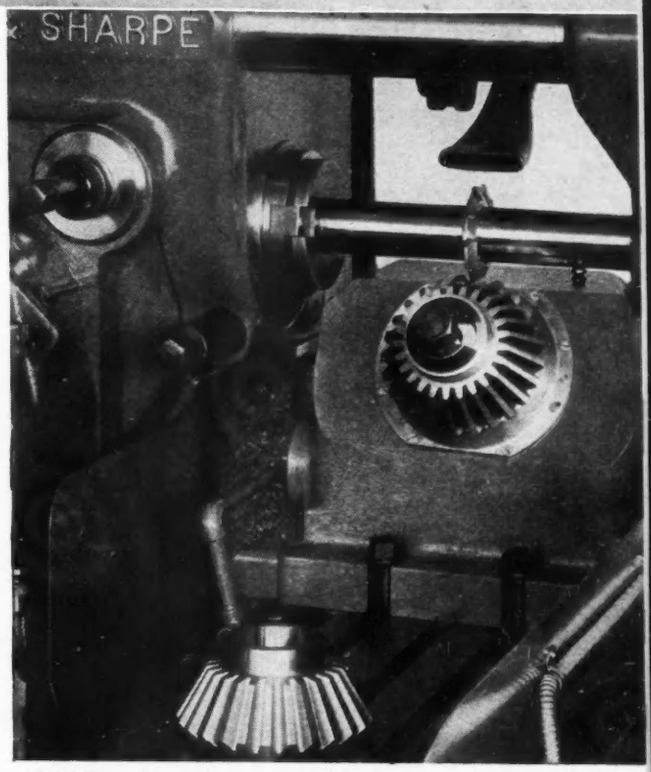
MILLING MACHINES — from the light, fast No. 000 to the powerful No. 12 — and a wide choice of toolroom as well as production equipment, including the unique Omniversal.

GRINDING MACHINES — for precision work large and small—universal, plain, surface, and tool.

SCREW MACHINES — Wire Feeds for quick set-ups — Automatics for parts in quantities.

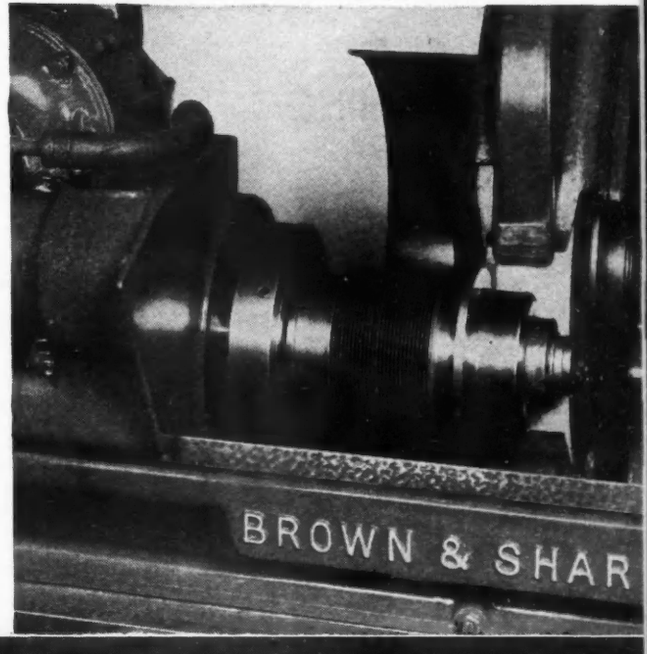
Aircraft manufacturers find the wide variety of types and sizes of these Brown & Sharpe machines give a selection of equipment for making parts at **low cost** – and to the high standards of the aircraft industry. Complete information on any machine gladly sent on request. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

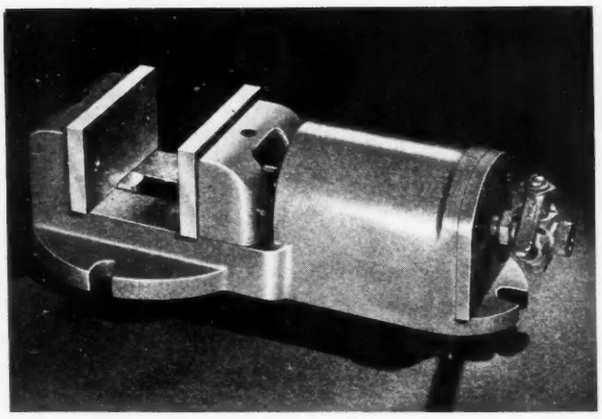


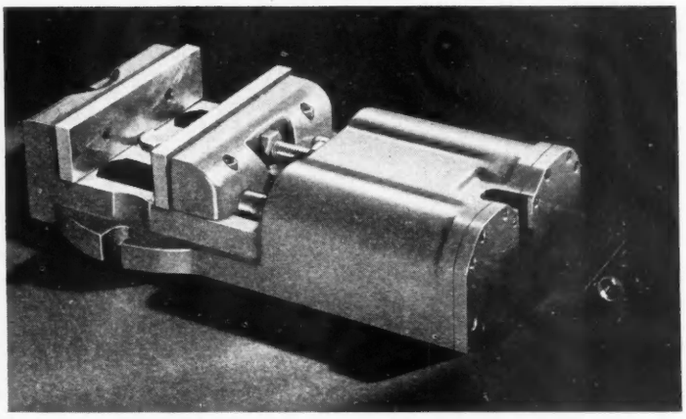
ABOVE — Gear for retractable landing gear efficiently rough milled on No. 12 Plain Milling Machine with automatic air-operated fixture.

BELOW — Accurately sizing base of cylinder mounted on air-operated expanding arbor in No. 20 Plain Grinding Machine equipped with revolving spindle headstock.



BROWN & SHARPE





Check PRODUCTION LINE EXPENSE with LARKIN AIR VISE

The *All-Purpose Unit*

For Use In

- MILLING
- DRILLING
- SHAPING
- PLANING
- TOOL ROOM
- MACHINE SHOP
- BENCH

The time element in production, chief item in assembly line costs, is efficiently and economically handled by the LARKIN AIR VISE. Reports from manufacturers using the AIR VISE show increased production of small parts . . . in some cases, as much as 50%. Accurately engineered and constructed of the finest materials, the LARKIN AIR VISE features "semi-steel" castings of high shock resistance and machinings of close tolerance. All models have hardened and ground, removable tool steel jaw faces, with the exception of No. O. Special jaws for any type work will be supplied at slight additional cost.

The LARKIN AIR VISE, designed for hand, foot or automatic operation, is adaptable to all types of installation. The safety stop is standard equipment on all but the smallest model.

Standard Models of LARKIN AIR VISE:

Model	*Jaw Width*	*Depth*	*Air Press. Req.*
0	3"	1¼"	60 lb.
1	4"	2¼"	100
2	5"	2¼"	100
3	6"	1½"	100
4	8"	2¾"	120

All models are regularly supplied with flanged base, hand operated air valve, and 12 ft. of high grade air hose.

Write today for prices and further information.

LARKIN INDUSTRIES

PORTLAND CONNECTICUT

Factory and Warehouse, 24 Stack St., Middletown, Conn.

KNOWLEDGE IS POWER

An industry, with reserves of energy and initiative, faces a sudden demand on all its resources. The machine tool builders of America are ready to meet this crisis. In continuation of its traditional policy, this company stands pledged to share the knowledge of its engineers with every agency authorized to aid the present program of preparation for defense.

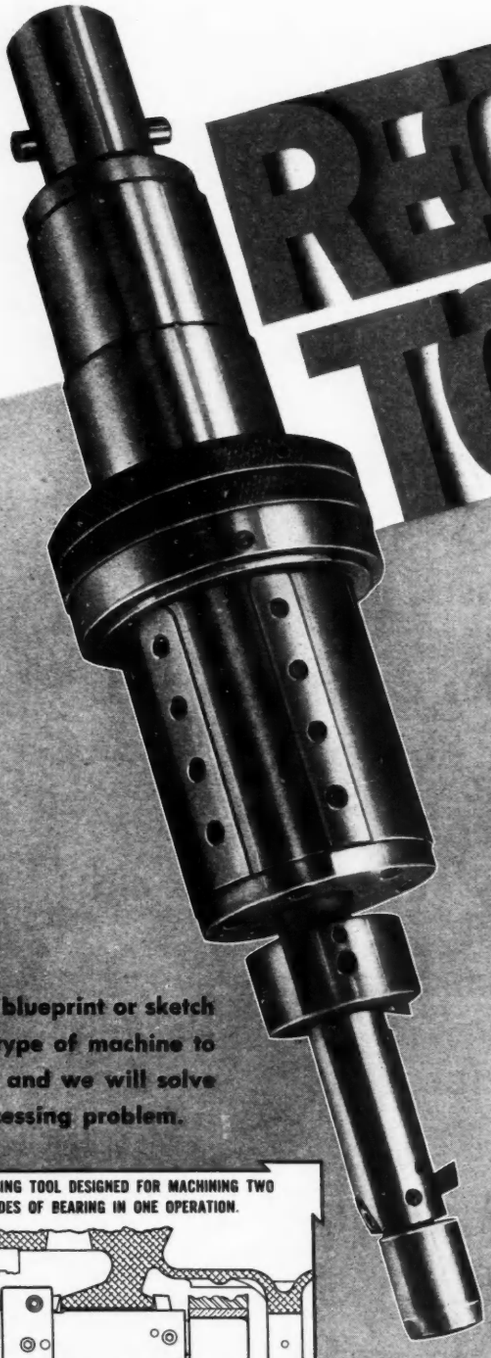
JONES & LAMSON MACHINE COMPANY

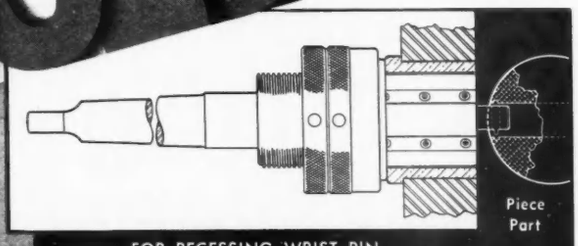
SPRINGFIELD, VERMONT, U.S.A.

MANUFACTURERS OF—SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS

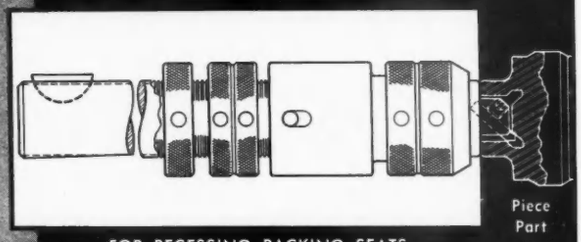
PROFIT PRODUCING MACHINE TOOLS

RECESSING TOOLS . . .

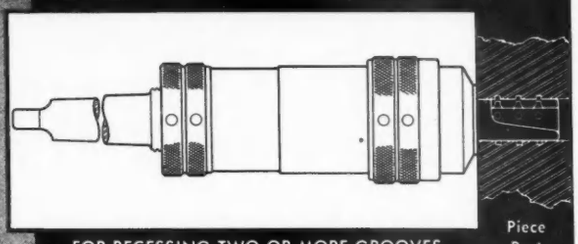




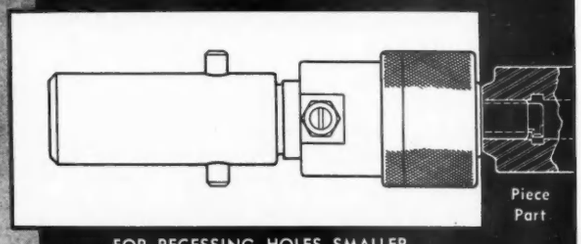
FOR RECESSING WRIST PIN HOLE IN PISTONS



FOR RECESSING PACKING SEATS AND VALVE SEATS



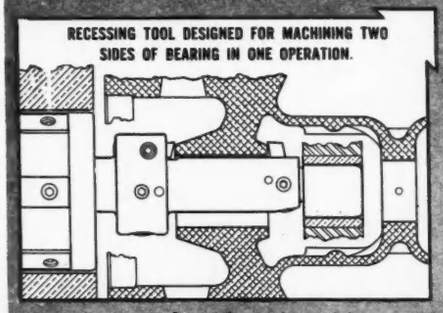
FOR RECESSING TWO OR MORE GROOVES IN CONDENSOR TUBE SHEET



FOR RECESSING HOLES SMALLER THAN $\frac{3}{8}$" DIAMETER

Send us blueprint or sketch — state type of machine to be used and we will solve your recessing problem.

RECESSING TOOL DESIGNED FOR MACHINING TWO SIDES OF BEARING IN ONE OPERATION.



• Write for Catalog No. 400 showing our full line of Production Tools.

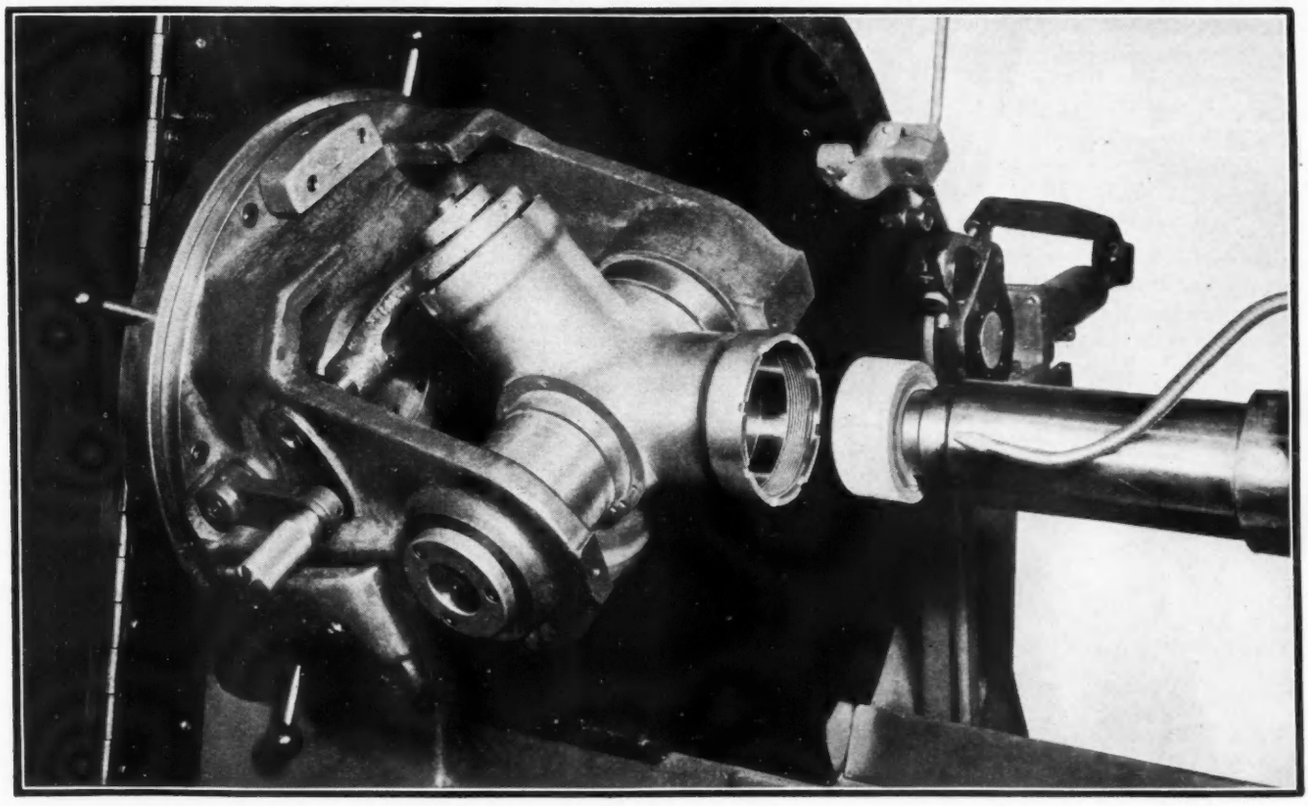
SCULLY-JONES AND COMPANY

MORE THAN A QUARTER CENTURY OF PROGRESS

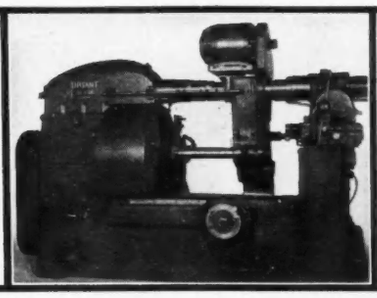
STANDARD & SPECIAL PRODUCTION TOOLS

1901 SO. ROCKWELL ST. CHICAGO, ILLINOIS

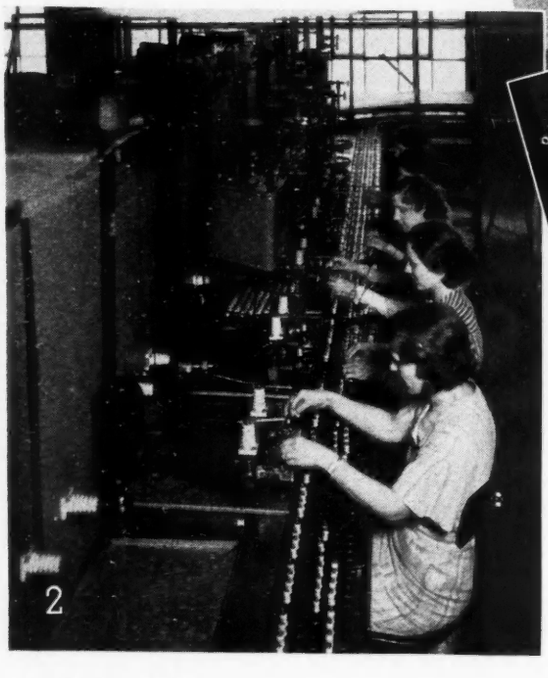
Giving Production a TAIL WIND,, BY GRINDING AIRPLANE ENGINE PARTS ON BRYANT GRINDERS



BRYANT Internal Grinders are like a "Tail Wind" to production schedules in the plants of aircraft engine manufacturers throughout the world. We illustrate the Bryant No. 24-36 with the exclusive Bryant feature of single slide control, and single lever operating control. This means faster handling, easier operation, and greater accuracy than any other machine offered for this class of work. This machine is shown grinding the inside bores in a three-blade propeller hub. The holding fixture is designed so that all three bores may be ground in one setting, merely by taking out the locating plug, revolving the fixture one-third of a revolution, and inserting the locating plug again. . . . Bryant experience in designing fixtures and machines to handle a wide range of jobs is a real asset — why not let us show you how to make profits on the tough jobs?



BRYANT CHUCKING GRINDER COMPANY
Springfield, Vermont



(*Continued from page* 295)

Pace Set By Quality Control

1. Studebaker connecting rod big end diameter is checked by means of the air gage shown here.

2. AC spark plugs are subject to close control from the time that raw materials are received in the plant. They are tested at each operation and, finally, the insulators are tested at 95,000 volts and the completed spark plugs checked by the final inspectors before shipping, as shown here.

3. Studebaker pistons and wrist pins are inspected in an enclosed and temperature booth. Interesting feature of the piston checking equipment is a special gage, foreground center, which permits the measurement of the elliptical skirt form at regular intervals around the periphery.

4. Unique machine for setting wheel alinement by inspectors at Studebaker has free alining rails to accommodate different treads both front and rear.

5. AC speedometer jewels are inspected under the microscope to assure precise alinement and surface quality.

At each factory is a chief inspector, who is in charge of all inspection at that works. Each of these chief inspectors has one general assistant. An important feature of the system is the fact that the chief inspector at a factory, while he works with the factory superintendent, is neither hired nor discharged by the superintendent, but is responsible to inspection department heads in Chicago.

Under the chief inspector at each works is a staff of department supervisors of inspection, varying in number according to the size and character of the plant's operations, but each having charge of a major department. For example, one department supervisor may be in charge of crankcases, main frames and heavy castings; another of crankshafts, connecting rods and pistons; another of screw machine work; another of gear cutting, hobbing, broaching and similar work, etc.

(*Turn to page* 422, *please*)

the production of motor trucks and farm and industrial tractors, is headed by a supervisor of inspection, located at the company's general office in Chicago. Immediately under the supervisor of inspection are two assistants, one in charge of the motor truck factories, the other in charge of the tractor factories. There are four factories in each group.

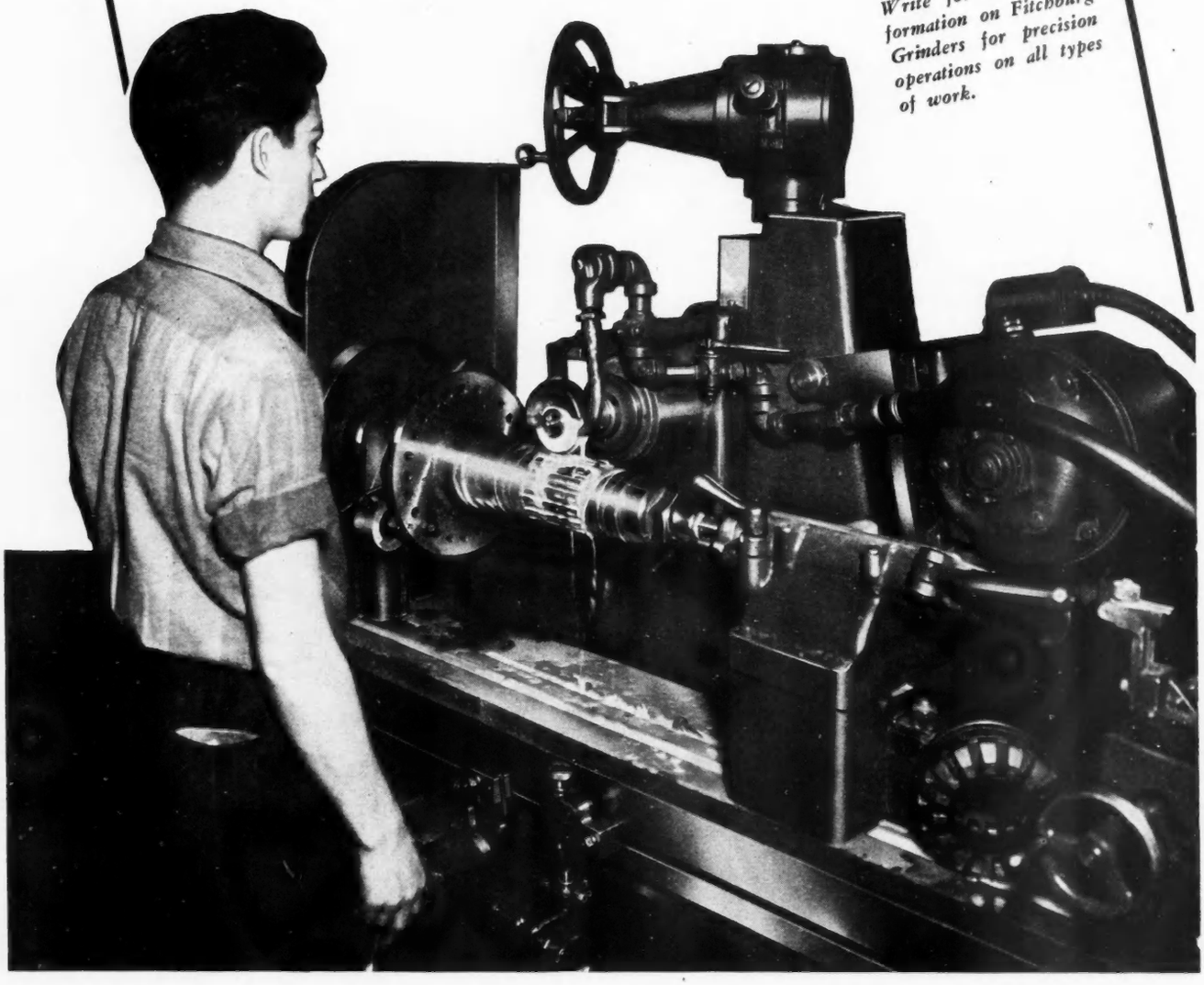
FITCHBURG
SPLINE and GEAR GRINDER

ASSURES ACCURACY AND FINE FINISH IN GRINDING WRIGHT PROPELLER HUBS

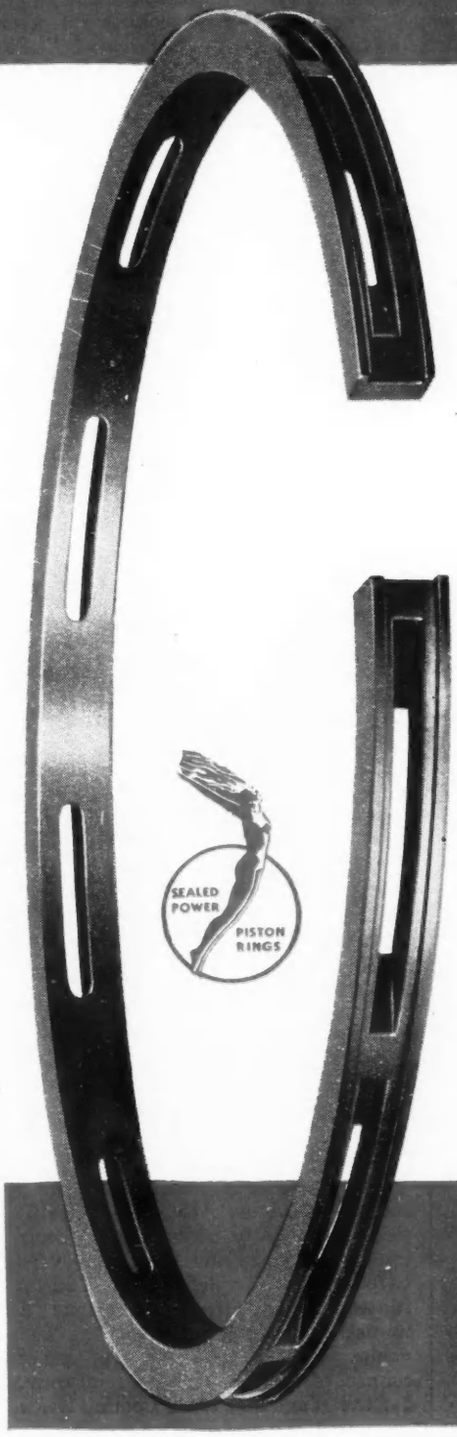
At the Wright Aeronautical plant, a Fitchburg Spline and Gear Grinder is used for the important operation of grinding splines on propeller shafts, assuring high accuracy and fine finish. For fast, accurate grinding of gears and spline shafts this new Fitchburg Grinder is semi-automatic in operation, with hydraulic traverse and two speed automatic vertical head motion. Wheel head column swivels 20° in either direction for grinding helical gears up to 12" diameter. Set up for spline grinding, it will grind straight, right or left hand helical splines up to, and including, 72 spacings.

FITCHBURG GRINDING MACHINE CORP.
FITCHBURG, MASS.

Write for detailed information on Fitchburg Grinders for precision operations on all types of work.



SEALED POWER'S *sensational* new oil control ring... the RT-20



announced only 6 months ago has already made piston ring history!

THE RT-20 has already been adopted by leading automobile and truck manufacturers for their 1941 models *because* the RT-20 ring is designed to give top performance from the time the engine leaves the assembly line. Ends oil consumption complaints on new models with equal or better oil economy over long period of operation. Write for complete details.

SEALED POWER CORPORATION
MUSKEGON, MICHIGAN
Canadian Factory, Windsor, Ontario

SEALED POWER PISTON RINGS

NIAA Hears Patterson Cite Industry for "Cooperation"

Assistant Secretary of War Avers That "Industry Isn't Looking for Great Profits in the Defense Program"

Robert P. Patterson, assistant secretary of war, praised industry for its cooperation in the national defense program when he addressed the annual conference of the National Industrial Advertisers Association Sept. 18 at Detroit.

"In some circles there evidently is some doubt about industry's readiness to cooperate," said Patterson. "During the debates on universal service, there were some drastic proposals that government take over and operate private plants. The law as finally passed by the Congress reserves to the government the right to take over recalcitrant plants which refuse orders. I am confident that the power will seldom be invoked. Such authority existed in 1917-18. It was used twice.

"There is no reason to believe that it will have to be invoked at all in the present armament program. On the contrary, there is every indication that industry is most willing to cooperate. No responsible official in Washington prefers governmental operation of industrial plants to private operation."

Patterson then cited the Chrysler Corp. and its satisfactory arrangement with the government in building and operating a tank arsenal at Detroit. He said there were no discordant notes and no threats of compulsion.

"Industry is not looking for great profits in the defense program," Patterson continued. "On the other hand, it does not want to incur a deficit. The whole problem of amortization is based simply on the understandable desire to get back what has been invested in a public enterprise at public request."

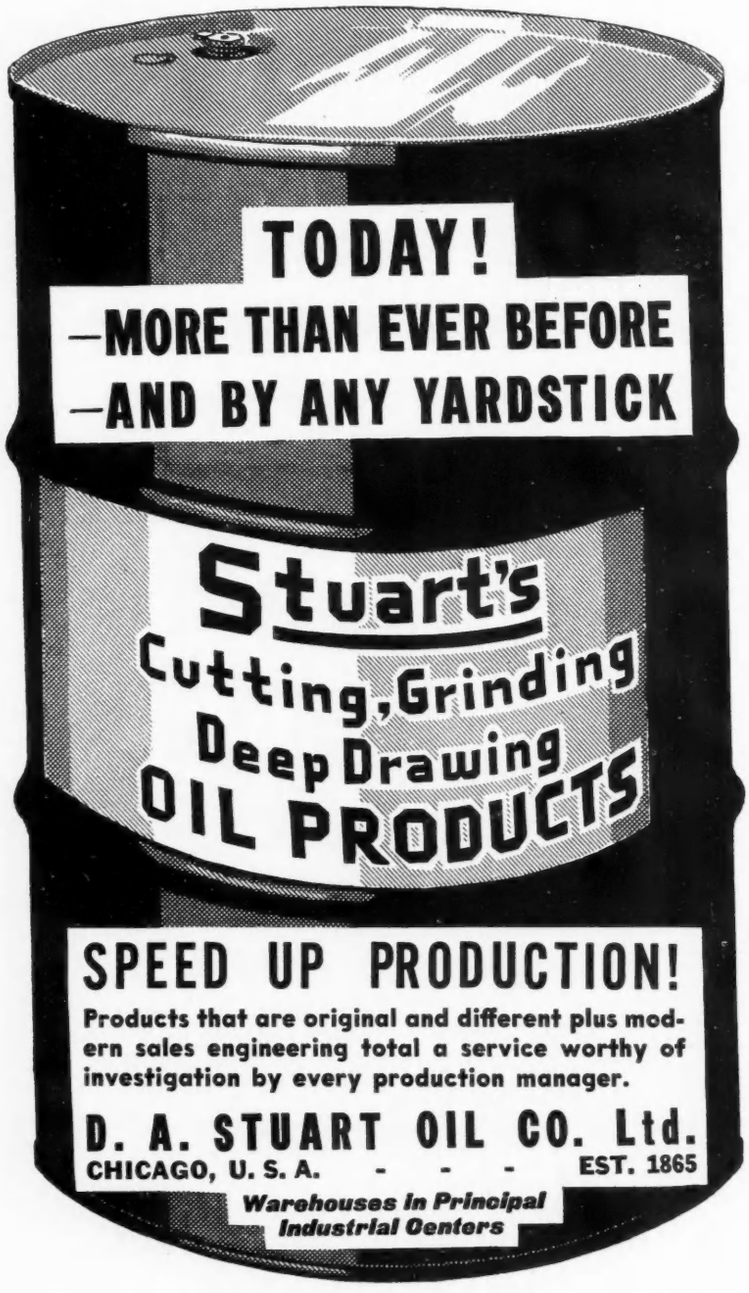
Patterson then helped allay industry's fears about conscription of key men who hold reserve or National Guard commissions. He said there were situations where a member of these organizations could perhaps serve his country better by remaining at his present post. He said that men who hold commissions in the National Guard or reserve, and whose retention in essential industries engaged in national defense contracts is absolutely necessary, may be transferred now to a War Department pool upon request by the company concerned.

In general, Patterson asserted, the military service of reserve officers employed in industries essential to national defense may be deferred by the War Department for a period necessary to effect their replacement. He promised that the government will not call men who are indispensable to the factories. However, a man must be so important that his departure would seriously hamper the factory's ability to accomplish an allotted preparedness assignment.

Patterson asked the N. I. A. A. to help educate the American public in what is being done in the armament program and not to encourage them to expect the impossible. He said the public must be made to comprehend the magnitude of the problem and to help in its solution.

NADA Seeks To Ascertain Dealer Wage-Hour Status

The National Automobile Dealers Association will seek to obtain clarification of the status of automobile dealers under the Wage and Hour Act by participating in the defense of a suit initiated by the Wage and Hour Administrator against a Dallas, Texas dealer. Charles W. Bishop, general counsel of N.A.D.A., and special counsel for the Wage and Hour Committee, will supervise the defense proceedings.


TODAY!
—MORE THAN EVER BEFORE
—AND BY ANY YARDSTICK
Stuart's
Cutting, Grinding
Deep Drawing
OIL PRODUCTS
SPEED UP PRODUCTION!
Products that are original and different plus modern sales engineering total a service worthy of investigation by every production manager.
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Write today for 48 page booklet with scientific chart showing modern cutting oil applications.

NEWS OF THE INDUSTRY

September Car Production Cracks 1939 Mark by 40%

Assembly Lines Now In High Gear As Manufacturers Rush To Supply New Models For Dealers' Showrooms

Production in the automobile plants swung into high gear in September as the manufacturers endeavored to supply their dealers with 1941 models for showroom purposes and to fill the mounting banks of new car orders from customers, some of whom were unable to get delivery on 1940 models when stocks were exhausted.

September output was estimated at 275,000 units, more than 40 per cent higher than September, 1939, when the total was 192,672. September production more than tripled August output of 89,866 motor cars and trucks by Department of Commerce records. Besides being the lowest production month of the year, August's total was the first time that a 1940 month was less than the previous year, going 13 per cent under the 1939 August figure.

For the week ending Sept. 21, production was estimated at 73,500 units, bringing the year's total over the 3,000,000 mark. General Motors manufactured 33,800 vehicles, while Chrysler, with DeSoto and Chrysler divisions just getting under way, turned out 17,700 units. Ford was nearing half its productive rate as it accounted for 8000 vehicles.

With its plant operating at nearly peak capacity, Studebaker led the independents, followed by Hudson and Packard. Nash just began 1941 model production in mid-September, including its new entry in the low-price field, while Willys started final assemblies late in the month. Graham temporarily suspended production.

Production was expected to climb to 88,000 units for the last week in September. The month had 20 working days, Labor Day cutting one off the total.

Although retail sales for August of 224,345 motor cars and trucks were 6.7 per cent higher than August, 1939, according to the Automobile Manufacturers Association, it marked the 22nd consecutive month in which retail deliveries have exceeded the same month of the previous year. Passenger car sales were 177,623 units, up 6.9 per cent, while commercial vehicles showed a 5.9 per cent increase to 46,722 units. Total retail sales for eight months of 1940 are 2,749,626 vehicles, an increase of 26 per cent over the same period of 1939.

General Motors consumer sales for August were 100,782 units, a gain of 33 per cent over August, 1939, but 31 per cent below July's unusually high sales. General Motors eight-month sales are up 35 per cent.

Early September sales reports were favorable, with Pontiac, Buick and Hudson reporting big gains for the opening 10-day period. However, many dealers are demanding cash deals, or large down payments of installment buyers of motor cars who are within the 21 to 35 draft age range. Price rises of from two to five per cent on 1941 models do not appear to have discouraged buying.

On the basis of records from 25 States, R. L. Polk & Co. estimates 210,000 new passenger car registrations and 47,500 new truck registrations during July.

Industrial Plants Get FBI Manual On Sabotage

Certain industrial plants working on defense contracts have been given copies of the government's confidential book on protective measures against sabotage and espionage.

The manual, compiled by the Federal Bureau of Investigation, has been available heretofore only to Federal agents, military and naval intelligence services and ranking police officers assigned to certain industrial establishments. Attorney General Robert H. Jackson emphasized at a press conference that the manual is still to be treated as confidential and is not being released generally to industry but only to those companies engaged in essential defense work.

Tank Arsenal in the Making

K. T. Keller, president, Chrysler Corp., drives the first tractor used to clear ground for the tank arsenal which the corporation is erecting in Detroit. With Mr. Keller is F. M. Zeder, vice-chairman of the board of Chrysler Corp.

Not a Kick in a Mile of it!
CLARK KICKLESS CABLE showing 720° Torsional Hand Twist in Direction Opposite Helical Winding
CLARK KICKLESS CABLE in Normal Position—No Torsional Twist
CLARK KICKLESS CABLE showing 450° Hand Twist in Same Direction as Helical Winding

• No Sir! There's no kick in Clark Kickless Cable—a water cooled electrical connection between the secondary taps of a welder transformer and a portable welder gun. The interweaving of cables of opposite polarity around a central soft rubber core, with a corrugated live rubber spacer, causes reactances to neutralize each other. This neutralization effectively eliminates the "kick" or jerking apart that characterizes the use of two separate cables.

And this "Kickless" quality helps production... because the gun can be placed and held accurately... the operator has no "kick fatigue" to overcome... more amperage is delivered at the tips... uniform amperage is delivered at all times.

Flexible? Yes, sir! The cable diameter is sufficiently small to allow bending into arcs of short radii. The cables are helically wound, and just a simple twist of the wrist permits torsional flexion of 450° from normal in the direction of the helical winding, and 720° from normal in the direction opposite to the helical winding. (See the chalk line on the special made, cord-reinforced, rubber tube in the pictures.)

Such twisting is visible evidence that torsional pliancy and bending sufficient for practically every welder gun application are found in Clark Kickless Cable.

FURNISHED IN TWO SIZES

400 M—equivalent to separate cables of 400,000 c. m.
750 M—equivalent to separate cables of 750,000 c. m.

WRITE FOR BULLETIN 7777 FOR COMPLETE DETAILS

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

BRING 'EM ON— WE'RE READY!

Ready for metal working and heat treating problems which are bound to rise as industry swings into action to meet the urgent need for national defense.

Armament and munition making are not new to us. Houghton did a major job during the last World War along lines of carburizing, heat treating, machining, rust prevention.

That cumulative experience has led to our present processing products — modern . . . geared to today's production needs... aimed at the one objective of quality performance at lower cost per unit produced.

If you face new, unfamiliar problems relating to the materials listed on this page, feel free to lay them before us. Call on the Houghton Man, or write, wire or phone:

E. F. HOUGHTON & CO.

Chicago - PHILADELPHIA - Detroit

CUTTING OILS

Soluble or straight oils and bases that assure finer finish, longer tool life, fewer rejects, speedier production.

CARBURIZERS

Pack-hardening compounds for armor plate and deeper cases . . . Liquid carburizers for fast production line hardening.

QUENCHING OILS

No. 2 Soluble—the standard for 25 years—still the leader for uniform depth of hardness and length of service.

RUST PREVENTIVES

Furnishing complete protection against rust . . . the modern Rust Veto line of slushes, oils and greases meeting government and industrial specifications.

DRAWING COMPOUNDS

A new, proven line-up for every type of drawing operation: shells, cartridge cases, automotive parts, etc.

HEAT TREATING SALTS

For hardening, reheating, tempering, blackening and treating high speed steel. Pure, stable salts with sharp melting points.

Automotive Firms Speed-Up National Defense Activities

Chrysler Erecting Tank Arsenal, Ford An Aircraft Plant, And Packard Contracts To Build 3000 Rolls-Royce Engines

National Defense activity in Michigan was accelerated during September as construction was begun on the Chrysler tank arsenal and the Ford aircraft engine plant at Detroit and the contract was closed with the Packard Motor Car Co. for $62,448,000 for the building of 3000 Rolls-Royce Merlin airplane engines. Government orders to Michigan plants totaled an estimated $304,723,347 as of Sept. 21.

Edsel Ford broke ground Sept. 17 for the Ford aircraft engine plant, just north of the new tool and die building on the River Rouge property. The structure, which will be two stories high except for a pair of four-story wings, will measure 1000 by 360 ft. and will have 800,000 sq. ft. of floor space. It will be windowless so that operations can be carried on during a blackout. The building will cost $4,000,000 and the equipment an additional $7,000,000. Many of the jigs and fixtures will be made by the Ford Motor Co. The production line will be on the main floor and the heavy machinery retooling will be on the second floor.

Production is expected to get under way by March 1, 1941 on the 2000 hp. Pratt & Whitney Wasp engines. Ford has agreed to build 4000 of these radial, air-cooled 18-cylinder engines for the government. Peak production will see the turning out of 16 engines per day on two eight-hour shifts. Charles E. Sorensen, Ford production chief, will be in charge of production. The plant will employ 5000 or 6000 men, many of whom will be selected from Ford apprentices for specialized aircraft engine training.

Ground was broken Sept. 10 for the $20,000,000 Chrysler tank arsenal on a 113-acre tract northeast of Detroit. A $650,000 order for steel construction with the Bethlehem Steel Co. has been let and the steelwork will be completed by late January. First production on the order for 1000 25-ton tanks is expected by September, 1941, at the rate of five tanks per day. This will be increased to a maximum of 15 tanks per day. The plant will employ 6000 workers on one eight-hour shift. The first 1000 tanks will cost $33,500 apiece, while the government has an option to order additional tanks at $27,500 apiece. E. J. Hunt will manage the plant, while Lieut.-Col. H. W. Rehn will exercise supervision for the War Department.

It took 197 Chrysler engineers four-and-a-half weeks to make a technical study of the tank blueprints. The transmission alone will require 1000 man-hours of labor.

The plant will occupy 700,000 sq. ft. and will have an adjacent proving ground for the tanks. Each tank will carry a crew of five, have a top speed of 40 m. p. h. and be equipped with one 37-millimeter, one 75-millimeter and one anti-aircraft gun.

In speaking on Chrysler Corp.'s contribution to the national defense program, K. T. Keller, president, stated, "The automobile industry's most substantial contribution to national defense grows out of its experience in developing the mass production technique that is necessary today in building for national security. Automobile plants do not become defense equipment plants overnight, but men experienced in automobile production know how to assemble the men, the materials and the machines that defense equipment manufacture on a volume basis requires."

Work is already under way at Packard for the building of 9000 Rolls-Royce Merlin 12-cylinder aircraft engines, 6000 for the British government. A $37,000,000 expansion program, $20,000,000 for new plant space and the rest for machinery, tools and dies, has been launched. A new plant adjacent

(*Turn to page* 398, *please*)

Ford Gets Started

Edsel Ford with P. E. Martin, Ford vice-president, center, and C. E. Sorensen, Ford production chief, at ground-breaking ceremonies marking the commencement of work on Ford's new airplane engine plant.

Passenger Car and Truck Production

(U. S. and Canada)

	August 1940	July 1940	August 1939	EIGHT MONTHS 1940	EIGHT MONTHS 1939	Per Cent Change
Passenger Cars—U. S. and Canada						
Domestic Market—U. S.	45,172	165,672	56,245	2,169,992	1,677,142	+29.5
Foreign Market—U. S.	1,651	3,097	5,162	73,030	117,154	−37.6
Canada	1,510	3,397	1,068	77,193	76,148	+ 1.3
Total	48,333	172,166	62,475	2,320,215	1,870,444	+24.0
Trucks—U. S. and Canada						
Domestic Market—U. S.	26,778	53,074	29,370	414,805	371,680	+11.7
Foreign Market—U. S.	2,272	9,860	9,901	78,277	105,240	−25.7
Canada	12,483	11,071	2,407	62,180	30,327	+105.5
Total	41,533	74,005	40,868	555,262	507,247	+ 9.5
Total—Domestic Market—U. S.	71,950	218,746	85,615	2,584,797	2,048,822	+26.0
Total—Foreign Market—U. S.	3,923	12,957	14,253	151,307	222,394	−32.0
Total—Canada	13,993	14,468	3,475	139,373	106,475	+30.7
Total—Cars and Trucks—U. S. and Canada	89,866	246,171	103,343	2,875,477	2,377,691	+21.0

Monthly Motor Vehicle Production *(U. S. and Canada)*

	PASSENGER CARS 1940	PASSENGER CARS 1939	TRUCKS 1940	TRUCKS 1939	TOTAL MOTOR VEHICLES 1940	TOTAL MOTOR VEHICLES 1939
January	375,476	292,869	74,016	64,093	449,492	356,962
February	350,535	253,914	71,690	63,606	422,225	317,520
March	364,947	312,392	75,285	77,107	440,232	389,499
April	375,626	286,200	76,807	68,066	452,433	354,266
May	338,353	249,055	74,139	63,793	412,492	313,248
June	294,779	257,289	67,787	66,964	362,566	324,253
July	172,166	155,850	74,005	62,750	246,171	218,600
August	48,333	62,475	41,533	40,868	89,866	103,343
8 Months	2,320,215	1,870,444	555,262	507,247	2,875,477	2,377,691
September	.....	165,119	.....	27,560	.....	192,679
October	.....	259,610	.....	65,079	.....	324,689
November	.....	295,134	.....	73,407	.....	368,541
December	.....	384,858	.....	84,260	.....	469,118
Total	.....	2,975,165	.....	757,553	.....	3,732,718

U. S. Warplane Output Now At 1000 Per Month

Since July 1 the War Department Has Contracted For Delivery Of 9174 Army Planes; New Awards Announced

The Aeronautical Chamber of Commerce announced on Sept. 19 that reports from its officials showed that American military airplane production had reached a total of approximately 1000 monthly and on the same day Secretary of War Stimson said that since July 1 the War Department had contracted for delivery of 9174 of the 18,641 Army planes for which Congress at the present session had made appropriations.

War Department awards made since those announced in AUTOMOTIVE INDUSTRIES of Sept. 1 include the following:

Consolidated Aircraft Corp., San Diego, Cal., airplanes and spares, $85,800,000.

Ryan Aeronautical Corp., San Diego, Cal., airplanes, $5,355,087.

Fairchild Aircraft Corp. (engine and airplane division), Hagerstown, Md., airplanes, $6,672,200.

Vultee Aircraft, Inc., Downey, Cal., planes and spares, $29,494,633.

Wright Aeronautical Corp., Paterson, N. J., plane engines, $6,829,144.

Beech Aircraft Corp., Wichita, Kan., training planes and spare parts, $13,115,138.

Boeing Airplane Co., Stearman Aircraft Division, Wichita, Kan., training planes and spare parts, $6,939,096; Seattle, Wash., bombers and spare parts, $59,762,850.

Glenn L. Martin Co., Baltimore, bombers and spare parts, $14,269,646.

Lockheed Aircraft Corp., Burbank, Cal., pursuit planes and spare parts, $15,646,450.

Douglas Airplane Co., Santa Monica, Cal., transport planes and spare parts, $20,229,184.

Bell Aircraft Corp., Buffalo, pursuit planes and spare parts, $19,896,668.

Republic Aviation Corp., Farmingdale, L. I., N. Y., pursuit planes and spare parts, $56,499,924.

Curtiss-Wright Corp., Buffalo, 540 pursuit planes and spare parts, $19,688,287; Robertson, Mo., 150 training planes and spare parts, $4,221,069 and 46 transport cargo type planes and spare parts, $12,410,116.

Aviation Mfg. Corp., Williamsport, Pa., airplane engines, $5,120,997.

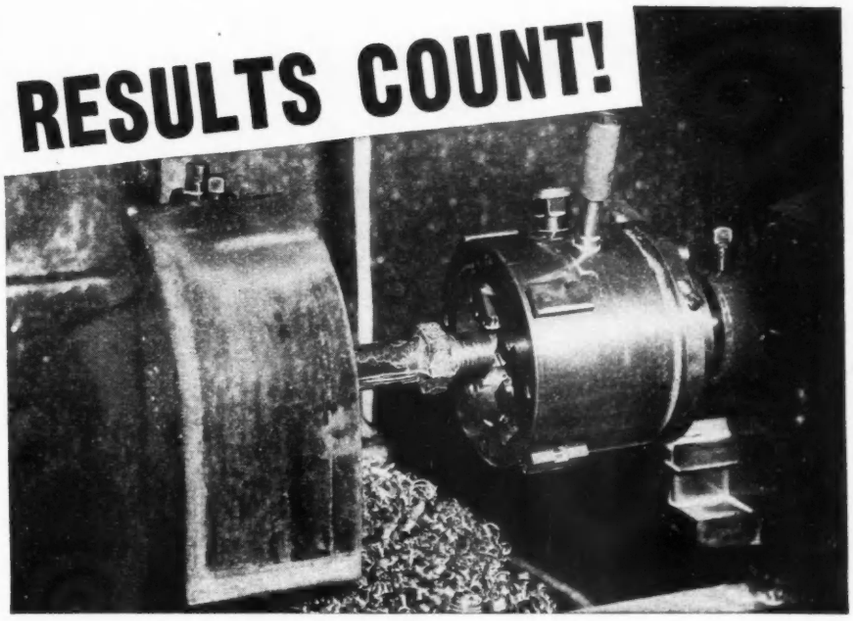
The Aeronautical Chamber said that of the total production of airplanes in the United States the British are receiving approximately 50 per cent or 500 a month.

American plants will not get "in real production" before next June, it was stated, on Army and Navy contracts now being awarded. It was estimated that by that time the completion of plants now under construction and delivery of machine tools now on order will step up production, possibly to 25,000 or 30,000 a year.

"The warplane production has moved out of Washington and is now within the four walls of factories," it was stated.

Delivery of new planes to England and Canada will be at the rate of about 550 to 575 a month by February, it was estimated, and probably will remain at that point until the spring of 1942 when the present plant expansion programs in the United States will have been completed and the maximum production rate is expected to be achieved. The National Defense Advisory Commission program provides for the delivery of 14,000 airplanes to Great Britain and 19,000 to the United States armed forces by April, 1942.

RESULTS COUNT!



"Excellent results for over five years have proved the value of Cities Service Cutting Oils in all of our operations, including threading, tapping and drilling," writes the purchasing director of a large electrical manufacturing company.*

This is but one of many examples where Cities Service Metal Cutting Lubricants have justified the title, "Service Proved." We will welcome an opportunity to tell you more about them and about our Lubrication Engineers' Service. Just fill out the coupon below and mail it for further information.

Copies of our booklet, "Metal Cutting Lubrication" are still available to users of metal cutting lubricants. Write for your copy today before the supply is exhausted.

*Name furnished on request.

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PRODUCTION SPEED-UP

THIS PLANT HAS THE ANSWER

GAS CUTTING MACHINES

Today's steadily increasing production requirements cause no delays at A. M. Castle Co., Chicago, as this picture so graphically illustrates. This plant is equipped with several types of Airco Gas Cutting Machines such as the Travographs, Oxygraphs and Radiagraphs shown in their steel warehouse speeding up production all along the line, thereby enabling A. M. Castle & Co. to render prompt and efficient service to their customers. » » You, too, may find the same answer to your production problems . . . Airco Gas Cutting Machines. There is a complete line to cover every cutting need.

Size and shape may vary to an almost unlimited extent — all are cut quickly, at low cost, with Airco Gas Cutting Machines.

Members of our Applied Engineering Department — through practical assistance — assure you best results in the application of these machines to your individual requirements.

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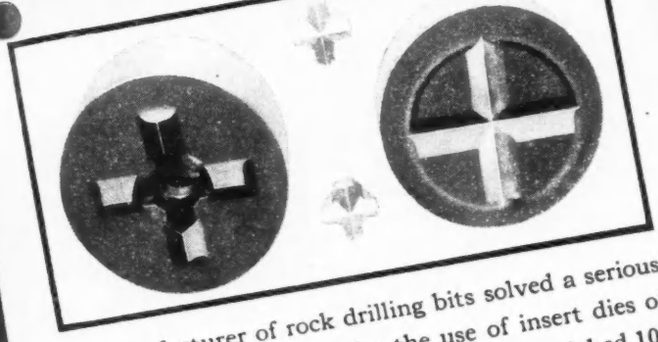
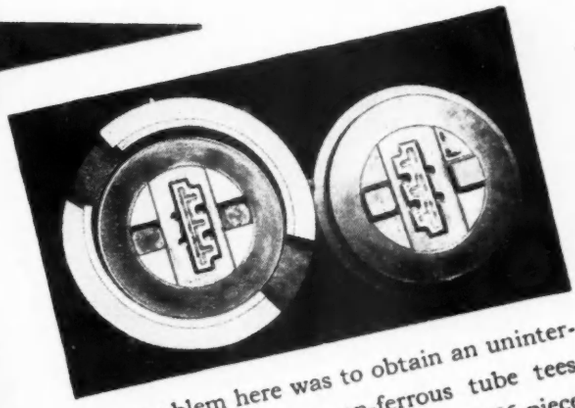
All Hot working Operations

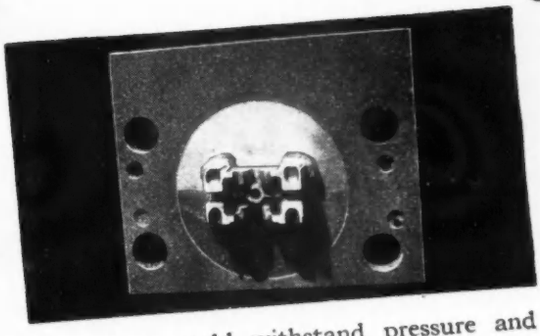
. . . but each requiring a die steel of *different characteristics*



A manufacturer of rock drilling bits solved a serious hot forging die problem by the use of insert dies of Mohawk Hot Die. These dies previously weighed 100 pounds. Now the insert dies and punch blanks weigh 13 and 15 pounds respectively. Die life has been greatly increased.

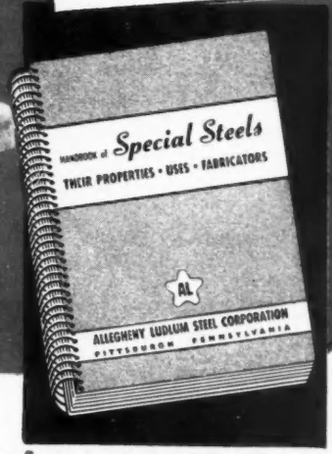


The problem here was to obtain an uninterrupted run forging non-ferrous tube tees. Dies of Atlas B had produced 255,266 pieces when this photograph was taken.



Dies that would withstand pressure and produce long runs was the basic consideration in the selection of the tool steel here. Dies of Seminole produced 150,000 parts at a pressure of 60,000 pounds per square inch.

Selecting **the RIGHT steel for each operation is reduced to a science when you have this 160 page book ➡**



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Tool Steel Division WATERVLIET, N. Y

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Sporadic Labor Trouble Flares in Four GM Plants

Two Fisher Body Plants, Detroit Diesel Engine Division and Chevrolet Motor Division Were Scenes of Disputes

Sporadic labor trouble in four plants of the General Motors Corp. marked the resumption of automobile production during September. Fisher Body plant No. 1 at Flint, Mich., the first Fisher Body plant at Pontiac, the Detroit Diesel Engine Division, and the Chevrolet Motor Division at Flint were the scenes of the disputes. Fighting between rival unions, the UAW-CIO and the UAW-AFL, broke out September 9 at Fisher Body No. 1 in Flint, causing the plant to close down and making 6800 workers idle. A shortage of bodies also resulted in the shutdown of the Buick Motor Division the next day, but work was resumed in both plants after 36 hours of idleness.

As a result of the inter-union friction at Fisher Body No. 1, 17 employes were suspended. While negotiations were carried on between the UAW-CIO seeking reinstatement of the men, and GM, the Fisher Body No. 1 local took a strike vote. Members voted 2303 to 957 to authorize the executive board to call a strike if deemed necessary, but this was interpreted as an advisory move and no strike was anticipated.

Meanwhile the UAW-AFL was granted an injunction by Judge Paul V. Gadola restraining members of the UAW-CIO from molesting or threatening UAW-AFL members employed at Fisher Body No. 1. In the NLRB election last April the plant voted for the UAW-CIO, 3722 to 2021.

Three hundred members of the Mechanics Educational Society of America, an independent union, walked out of the Detroit Diesel Engine Division plant September 13, charging a deliberate slow-down of grievance procedure by GM. Four points regarding the status of certain employes in relation to pay increases and vacation pay were at issue. However, GM charged that the union violated the contract, signed July 26, by not allowing a week's time for consideration of the grievances, and by going on strike without filing the five-day notice as required by the state.

The plant, which manufactures fuel injectors for the Cleveland Diesel Division, was still operating with approximately 300 of the 600 workers on the job 10 days after the walkout. Several instances of violence against those working had been reported.

Five employes of the Flint Chevrolet plant were suspended as the result of a dispute September 10 over the right of bargaining committee members to enter the plant when they pleased. Several hundred other workers in the sheet metal unit walked out as a result of the incident, but returned two days later after the question of reinstatement was submitted for negotiation between GM and the union.

Commenting on the labor disturbances, M. E. Coyle, general manager of Chevrolet, said, "When cars begin to move into dealers' hands, it can be expected that labor leaders will seize upon the opportunity it presents for collecting dues."

Production difficulties which had retarded operations at the Fisher Body Pontiac Division and at the nearby Pontiac Motor Division were ended September 7, when an understanding was reached between GM and the UAW-CIO. The dispute over body trim inspection and timing standards had interrupted production for more than a week.

The UAW-CIO and the National CIO each contributed $50,000 to a fund to finance the drive for organizing the Ford Motor Co., according to announce-

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The series of lapping operations performed as a matter of course in the Strom plant give Strom Steel Balls a degree of surface smoothness and sphericity that has always been unequalled in any other regular grade of ball. Only through such unique lapping practice can extreme precision be obtained.

Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Strom Balls.

Other types of balls—*stainless steel, monel, brass* and *bronze*—are also available in all standard sizes. Write for catalog and prices.

Strom STEEL BALL CO.
1850 So. 54th Avenue, Cicero, Ill.
The largest independent and exclusive Metal Ball Manufacturer

ment made at the meeting of the executive board of the UAW-CIO in Buffalo. Michael Widman, assistant director of organization for the CIO, has been placed in charge of the drive. Allan S. Haywood, national organizational director for the CIO, and Walter Smethurst will head the campaign to organize workers in the aircraft industry. In this field the UAW-CIO will be competing with the AFL machinists' union and several independent labor organizations.

Counsel for the UAW-CIO filed a motion September 12 with the Michigan Supreme Court for an early hearing on the union's appeal from an injunction of Judge Leland W. Carr preventing payment of jobless benefits to 23,000 Chrysler workers made idle by last fall's 54-day strike. The union charged that Judge Carr had no legal right to hold up the benefits after two proper authorities, the referee and the Appeal Board of the Michigan Unemployment Compensation Commission had awarded them. The Supreme Court reconvenes this month after the summer recess.

The UAW-CIO filed a complaint September 19 with the NLRB against the Lincoln Motor Division of the Ford Motor Co. charging that 11 men had been laid off for union activity.

MEN . . . . . .

Louis R. Morony has been named head of the field relations department, Automobile Manufacturers Association. Mr. Morony, for the past two years, was executive director of the American Association of Motor Vehicle Administrators.

John E. Garlent has been elected to the new post of executive vice-president of the Motor Wheel Corp., Lansing, Mich. He will continue as vice-president in charge of manufacturing.

L. A. Chaminade, formerly chassis units engineer, has been promoted to the position of design engineer for Chevrolet Motor Division of General Motors Corp. He succeeds **E. S. McPherson,** who becomes counsellor on national defense work for Chevrolet in Washington. **E. G. Sprung** will take over Chaminade's previous work on chassis units and assume complete responsibility for passenger car chassis design. **A. R. Stovall** has been advanced to truck chassis engineer to succeed **J. W. Diderich** who has been promoted to the position of federal transport engineer. **R. B. Wuerfel** formerly held this post along with that of State and municipal transport engineer but due to the increase in work the responsibility has been divided and Diderich takes over the Federal duties.

W. Richison Schofield, formerly chief engineer of Leeds & Northrup Co., Philadelphia, Pa., was recently appointed director of engineering. **John W. Harsch,** assistant chief engineer, has been advanced to chief engineer, and Mr. Harsch's former position has been filled by the promotion of **John F. Quereau.**

Marvin E. Coyle, general manager of the Chevrolet Motor Division and a vice-president of General Motors Corp., in ceremonies held recently at the New York World's Fair, received the Goodrich Award for "distinguished public service." In presenting the award in recognition of Mr. Coyle's "valuable service to the country in the important field of transportation," John L. Collyer, president of the B. F. Goodrich Co., cited him as a man who "typifies the opportunities afforded in our nation to ambitious and deserving youth."

Louis J. Colombo, chief counsel for the Ford Motor Co., has tendered his resignation effective Oct. 1. He was a member of the Ford legal staff for 12 years and figured in several cases involving the NLRB.

C. C. Codding has been appointed West Coast manager for Crosley automobiles, with headquarters in Los Angeles, Calif.

ONLY LAPPING *As Strom Does It* CAN PRODUCE SUCH PRECISION

Strom Steel Balls possess a degree of surface smoothness and sphericity that has never been equalled in any other regular grade of ball. Such precision is exclusive with Strom because it can be attained only through a series of lapping operations such as are standard practice in the Strom plant.

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Other types of balls—*stainless steel, monel, brass* and *bronze,* are also available in all standard sizes. Write for complete details.

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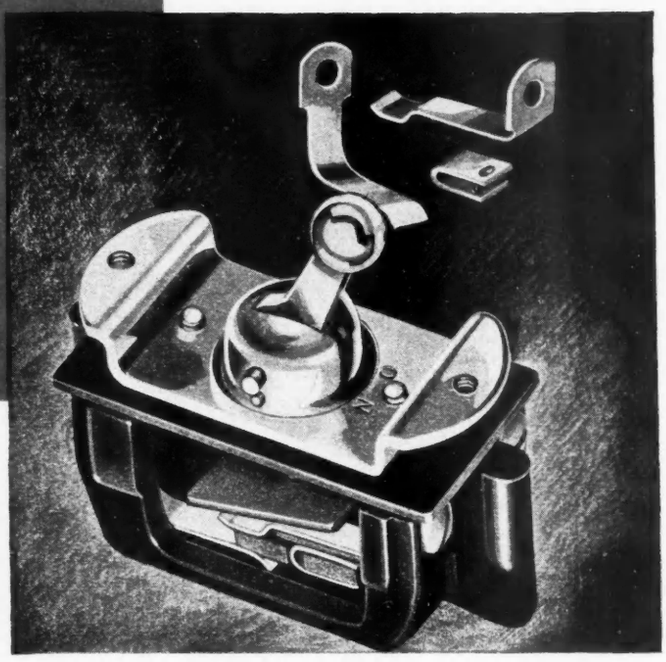
The largest independent and exclusive Metal Ball Manufacturer

Tough Job Meets Match in MALLORY Metals



Switch Manufacturer Takes Advantage of Mallory Alloy's Unique Combination of Hardness, Conductivity and Spring Qualities

Here was a job that called for qualities in a metal that seemed almost impossible to combine. These spring contacts, working under heavy pressure had to afford the high conductivity of pure copper, and still provide excellent hardness and fatigue resistance.

All of the previously tried alloys failed in one respect or another. Then Mallory was brought into the picture. After exhaustive research and severe life tests, Mallory solved the problem with Mallory 100 Metal. If you have a metallurgical problem to solve, remember that no small part of Mallory's service is the assistance of expert metallurgists. When they know your problems, you can be certain that their knowledge and experience will disclose the right alloy for the right job.

And, of course, Mallory has the *right* electrical contact for every service where a current must be made or broken.

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Check these properties of Mallory 100 Metal

Property	*Wrought*	*Heat-Treated Castings*
Tensile Strength, psi	100,000	90,000
Elongation in 2"	12%	8%
Rockwell B Hardness	95-100	93-100
Electrical Conductivity (% of copper)	50%	45%
Thermal Conductivity	.50 cal./sq.cm./cm./sec./deg. C	.50 cal./sq. cm./cm./sec./deg.C
Proportional Limit	80,000	50,000
Softening Temperature	500° C (932° F)	500° C (932° F)

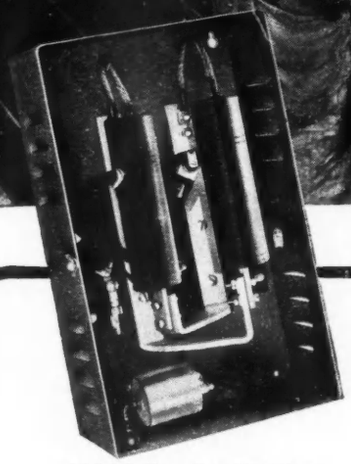
P. R. MALLORY & CO. Inc.

MALLORY

NON-FERROUS ALLOYS and ELECTRICAL CONTACTS

HERE'S THE ANSWER TO *BETTER · FASTER · LOWER COST* RESISTANCE WELDING

Six Weld-O-Trols recently installed at a well-known automotive body plant.



WELD-O-TROL

THE NEWEST DEVELOPMENT IN RESISTANCE WELDING GIVES YOU THESE ADVANTAGES:

REDUCED OUTAGE CHARGES— current turned "on" and "off" 600 or more times per minute.

BETTER WELDS — no mechanical delay — no stopping and starting.

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Results prove you'll cut maintenance, improve welds and step up production by using the newest method of current interruption for resistance welding, the Weld-O-Trol—the latest development in power switches.

Weld-O-Trol eliminates burned welds and maintenance on pitted contacts because it HAS NO MOVING PARTS.

Weld-O-Trol's timing is more accurate—its maximum speed of circuit interruption faster (600 times, or more, per minute). Because Weld-O-Trol has NO MOVING PARTS there's complete freedom from time delay—full advantage taken of the accuracy of your timer. And it will operate with your existing timer.

Learn more about this most important contribution to resistance welding. Let us show you interesting performance figures on what Weld-O-Trol is doing in leading industrial plants. Write today for bulletin F-8451-A.

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Westinghouse Weld-O-Trol

Steel Industry Expanding To Meet Armament Orders

Heavy Buying of Metal by Automobile Firms for Defense Work Will Start When New Production Facilities Near Completion

National defense contracts, so far awarded to automobile manufacturers, call for the most part for much time-consuming installation of equipment before purchases of steel and other metals can come up for attention. Meanwhile, however, the steel industry itself is expanding its facilities for the production of certain classes of steel which will be needed in increasing quantities, as the armament program gets under full headway. For one thing, capacity for the making of quality steels is being lifted by the addition of electric furnaces from approximately 1,500,000 tons annually to 2,000,000 tons. This increase is expected to be attained by the end of this year, and further additions may be looked for in 1941.

For most purposes alloy steels produced in open-hearth furnaces come up to all requirements, but for certain grades of steel to be used in defense equipment as well as in the tools, by which it is fashioned, the electric furnace product is specified. Cost of making steel in the electric furnace depends on the price of current in a given plant, but that it is higher than when steel is made by the open-hearth process, in which furnaces with much greater capacity are used, is certain.

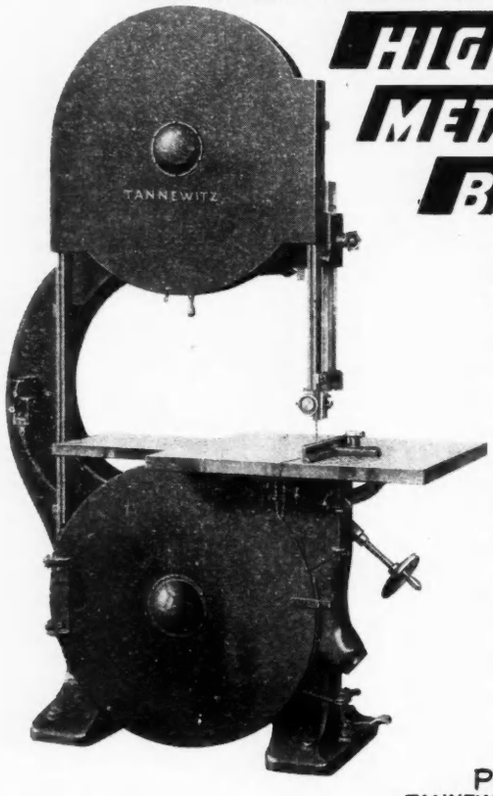
Steel producers are also adjusting their facilities so as to be able to care for the increased demand for forging material that the armament program is expected to bring. It is largely because production of the ordinary commercial forms of steel, such as sheets and strip steel, has become the routine affair it is, that the steel industry is able to turn its thoughts to the special requirements of the defense program.

Specifications and shipping orders of automobile manufacturers continue to hew close to nearby assembly schedules. Some of the sheets being shipped to them are what there is still left unfilled of the tonnage ordered last spring at below current price levels. According to the American Iron and Steel Institute, operations for the week ended Sept. 21 were at the rate of 92.9 per cent of ingot capacity, compared with 91.9 per cent in the preceding week. With the present rate denoting an output of about 950,000 tons of finished steel a week, the million ton level may be reached before long.

Prices for secondary aluminum alloys

Cut it FASTER, BETTER with

TANNEWITZ HIGH-SPEED METAL-CUTTING BAND SAWS



The speed with which these machines cut sheet metal up to ¼" thick, tubing and kindred articles with perfect safety, and the smooth character of the work they do is little less than amazing to those who witness it for the first time. (See chart below.) Labor savings ranging from 25% to 90% over other methods of cutting are the usual thing and one of the reasons these highly developed machines are widely used in the manufacture of automobiles, airplanes and products of hundreds of other metal working plants. For complete details simply write for bulletin on metal cutting band saws.

• Precision built with many patented features essential to successful high speed operation.

•

• Saw blade travel of more than two miles per minute gives tremendous sawing capacity.

•

• ABSOLUTELY SAFE — Both wheels are completely guarded. Synchronized two wheel hydraulic brakes —automatic in case of saw breakage.

•

• "SPEEDI-CHANGE" true running tires on perfectly balanced wheels.

PRODUCTION CHART
TANNEWITZ 36"&42" HIGH SPEED METAL CUTTING BAND SAWS

	Thickness and feed per second in inches							
KIND OF MATERIAL	1/32	1/16	1/8	1/4	1/2	1	2	3
MILD STEEL	12-24	6	3	1				
STAINLESS STEEL	6	2	1					
YELLOW BRASS, ZINC	24	12	6	3	1½	¾	⅜	3/16
BRONZE OR COPPER	6	3	1½	¾	⅜	3/16		
ALUMINUM	24-36	18	9	4½	2	1½	1	¾
DURALUMINUM	24	12	6	3	1½	1	¾	½
SINGLE PLYMETAL				6	4			
DOUBLE PLYMETAL				4	3			
PLYWOOD	24-36	24	20	16	12	6	3	1½
ASBESTOS BOARD	12	6	3	1½	¾			
FIBRE (HARD)	24	12	6	½				
PAPER BOARD	24	18	12	4	2	½		
MASONITE	24	18	12	6	3	1½	¾	⅜
BAKELITE	12	6	3	1½	¾	⅜	3/16	

THE TANNEWITZ WORKS, GRAND RAPIDS, MICHIGAN

CALENDAR

Conventions and Meetings

SAE Annual Dinner, New York.....Oct. 14
American Society for Metals, Annual Meeting, Cleveland, Ohio.....Oct. 21-25
American Welding Society, Annual Meeting, Cleveland .....Oct. 20-25
SAE Nat'l Aircraft Production Meeting, Los Angeles .....Oct. 31-Nov. 2
SAE National Fuels & Lubricants Meeting, Tulsa, Okla. .....Nov. 7-8
Aeronautical Chamber of Commerce of America, Inc., Annual Meeting, New York .....Dec. 5
National Association of Manufacturers, Annual Meeting, New York....Dec. 9-13
SAE Annual Meeting, Detroit, Jan. 6-10, 1941
National Automobile Dealers Association, Convention, Pittsburgh, Pa. Jan. 20-23, 1941

Shows at Home and Abroad

Detroit Automobile Show .....Oct. 12-19
National Automobile Show, Grand Central Palace, New York.....Oct. 12-20
Pittsburgh Automobile Show.....Oct. 19-26
National Metal Congress & Exposition, Cleveland, O. .....Oct. 21-25
Chicago Automobile Show....Oct. 26-Nov. 3
Automotive Service Industries Show, Chicago .....Dec. 9-14
Machine & Tool Progress Exhibition, Detroit .....Mar. 24-29, 1941

were fractionally advanced in some of the inland markets in the week ended Sept. 21. Straits tin could have been bought at 50.05 cents early the same week, but consumers showed no interest in offerings. On higher cables from London, the market moved upwards, 50¼ cents per pound being quoted for spot metal. Tin stocks in this country are said to have mounted in the last month or two to a point, where the country's needs for the next eight or nine months could be supplied from warehouse inventories. This is being used as an argument against haste in extending Government aid to the construction of a United States tin smelting plant. Discussion of this project, however, continues in Washington.

With the Connecticut Valley brass industry working three shifts a day and orders for armament requirements piling up, domestic copper consumption runs high. In the outside market a premium is being asked over the price quoted by custom smelters, 11⅜ cents a pound.—W. C. H.

Ourselves & Government

A Check List of Federal Action Corrected to Sept. 23

FEDERAL TRADE COMMISSION

GM EXCLUSIVE DEALER CASE. Tentative date fixed for Oct. 15 for final arguments in Washington.

F.O.B. PRICE CASE. The commission is awaiting respondent's brief in the GM case. The Ford case is still open for testimony but no dates have been fixed.

TRADE PRACTICE RULES. Opinion divided as to whether rules, which are opposed by the trade, will be promulgated. No immediate decision in sight.

PUBLICATIONS

A booklet entitled "Electronic Devices for Industry" (GES-2411), published by the General Electric Co., Schenectady, N. Y., briefly lists some of the more important **vacuum-tube apparatus** and describes its application and method of operation.*

A booklet illustrating and explaining 61 different spring tension **speed nut** applications used in the assembly of a wide variety of products has been prepared by Tinnerman Products, Inc., Cleveland.*

Gibson Electric Co., Pittsburgh, Pa., has prepared a catalog to illustrate and describe Gibsiloy **electrical contacts** made from ductile powdered metals.*

Young Radiator Co., Racine, Wis., has prepared two new catalogs. No. 2540 describes Young "Vertiflow" unit **heaters** for industrial heating. No. 4540 is concerned with commercial heat transfer units and booster units for air conditioning and industrial applications.*

Engineering properties of **Monel** are discussed at length in Bulletin T-5 prepared by the Development and Research Division of the International Nickel Co., New York, N. Y.*

McKenna Metals Co., Latrobe, Pa., has issued a new chart listing the horsepower requirements for cutting steel with **Kennametal-tipped tools.***

Carbide & Carbon Chemicals Corp., New York, N. Y., has published Chemical Group Folder No. 2 on **"Glycols,"** another of a series of folders which present the properties, uses and possibilities of organic chemical families. In this folder, ethylene glycol, several polyethylene glycols, propylene glycol, and dipropylene glycol are described, and a table of reference data on commonly used physical constants and solubilities of these glycols is given.*

"The Answer to Industrial Dermatitis" is the title of a booklet published by the Milburn Co., Detroit.*

Blaw-Knox Co., Pittsburgh, Pa., has prepared a new catalog (No. 1773) on its electroforged **steel grating and stair treads.***

"Lynite Lo-Ex Aluminum Pistons and Aluminum Cylinder Heads" is the title of a publication issued by the Aluminum Co. of America, Pittsburgh, Pa. It deals with aluminum pistons and cylinder heads from the engineering standpoint and in considerable detail.*

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

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Precision Machining

Operator engaged in the superfinish of pistons

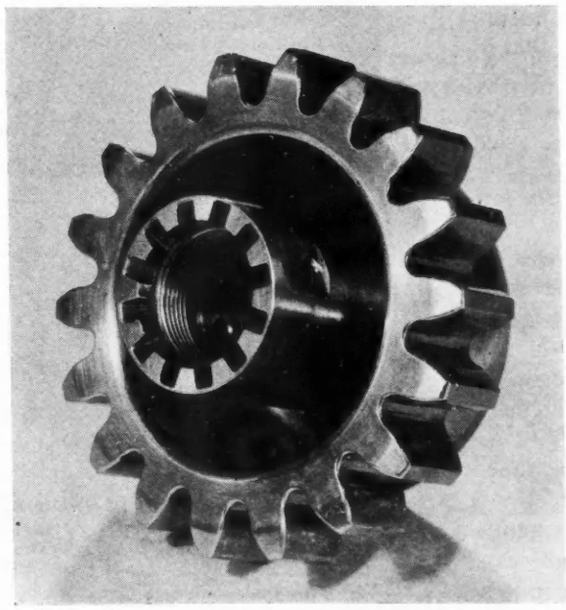
By ARTHUR M. SWIGERT, JR*.

PRECISION machining is a term used to denote the manufacture of parts in large numbers, all of which are identical in dimensions. Without mass production there would be no "precision manufacture." Likewise, if parts could not be manufactured in large numbers, each of the same dimensions as all others, there would be no precision manufacture.

The degree of precision in manufacturing varies to a certain extent with the industry in which the manufacturing is done. It is limited by the accuracy of the tools, machines and gages available.

What was termed precision manufacturing in the olden days would be considered very rough manufacturing practice at the present time. However, as the different industries have problems peculiar to themselves, what one concern considers precision work would be normal machining practice to another.

In the early days of manufacturing, when mechanical equipment was built in single units, and practically hand-fitted together, the degree of precision for the individual unit could be said to be as great as that now maintained in mass-production industries. However, the results were not the same, because each individual machine, while well made and accurate in itself, lacked the element of interchangeability between different machines that we have today.

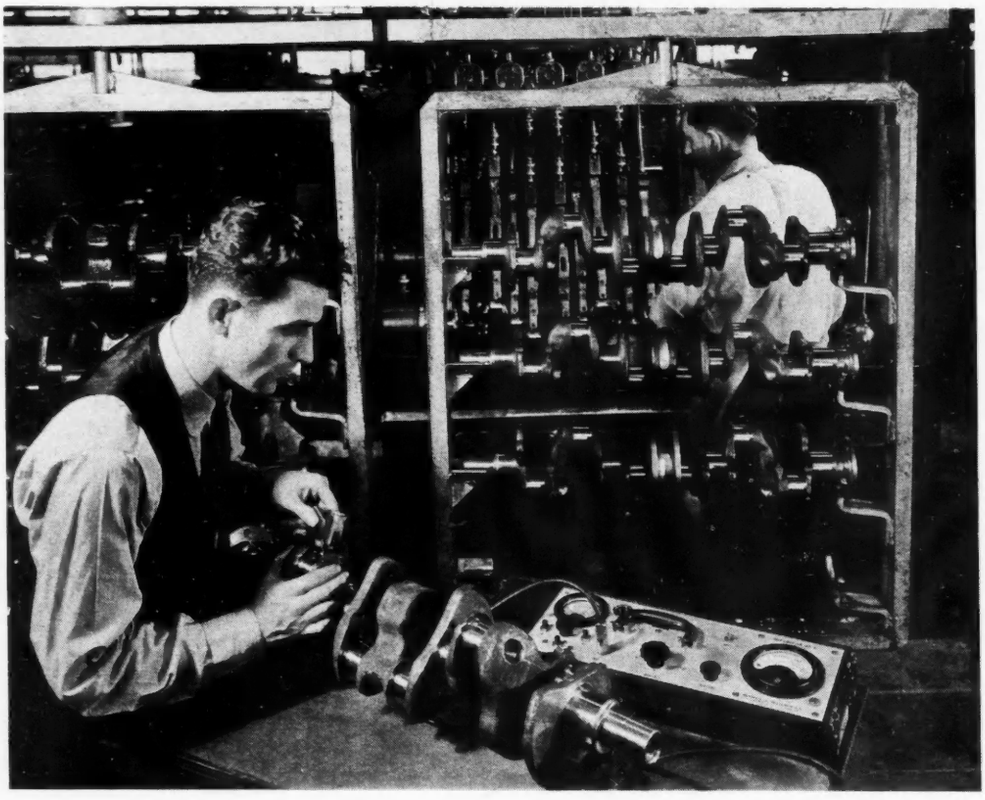


Superfinish can be applied to gear production.

This difference has been emphasized in recent discussions on the production of aircraft engines on a scale similar to that on which automobile engines are now being produced. It has been stated that precision work in the pro-

SUPERFINISH

* Director of Production Research, Chrysler Division of Chrysler Corp.



The crankshaft superfinisher in the background is Superfinishing all pin and main bearings simultaneously. The time for this operation is one minute.

In the foreground an operator is shown measuring a crankshaft with a Profilometer.

duction of aircraft engines means that each part must be identical with all similar parts made for a certain engine.

This does not differ essentially from high-production automotive machining, except that automobile parts are machined to close tolerances and then divided into size groups within these tolerances for most efficient production and operation.

Reason for Precision Manufacture

One reason for precision manufacture in mass-production industries is that it decreases the cost (time) of assembling thousands of parts into complete units such as tractors or automobiles. This makes possible mass production of completely assembled units at relatively low cost.

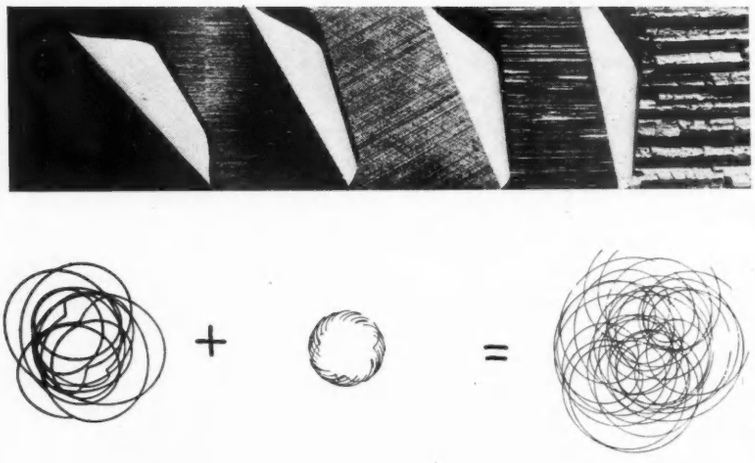
Aside from keeping down the cost of manufacturing and assembling, precision manufacture reduces the upkeep or maintenance cost of the device, due to the dimensional accuracy of each component part. During the past few years surface-finish quality has become recognized as of equal importance to the proper functioning of the unit.

One of the bases of precision manufacturing must be speed, as there can be no precision mass production unless the element of low cost through high production can be maintained.

High-speed, high-production precision manufacture has been in the past, and will be in the future, largely dependent upon the tool equipment used. As in all manufacturing, the relatively small tool point or tool bit is of primary importance. Regardless of the size of a machine, its performance is dependent primarily upon a minute fraction of its total weight or total cost—the cutting tool itself.

It always has been an interesting thought that all of the millions of dollars spent for machine tool equipment bring no returns until the minute tool point has produced parts which are of use in building up serviceable products.

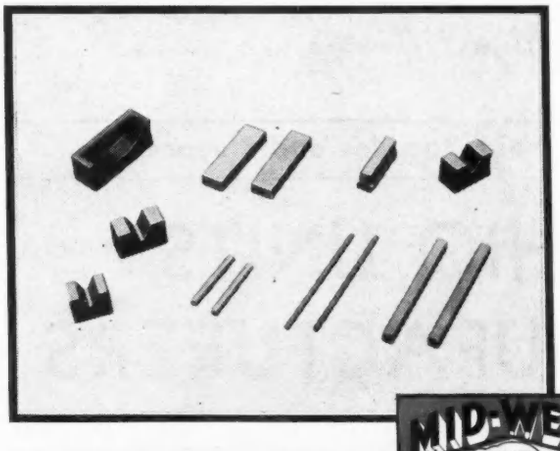
(*Turn to page* 390, *please*)



(Top) Plan view photomicrographs to graphically illustrate the peeling away of surface layers as refine machining processes are used.

The lower picture graphically illustrates the abrasive grit path of a Superfinishing operation. This variation of grit path is one of the basic principles of the Superfinishing process and is called multimotion.

GUESSWORK AND VARIATION IN SUPERFINISHING *Eliminated!*



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UNIVERSAL *Superfinisher*

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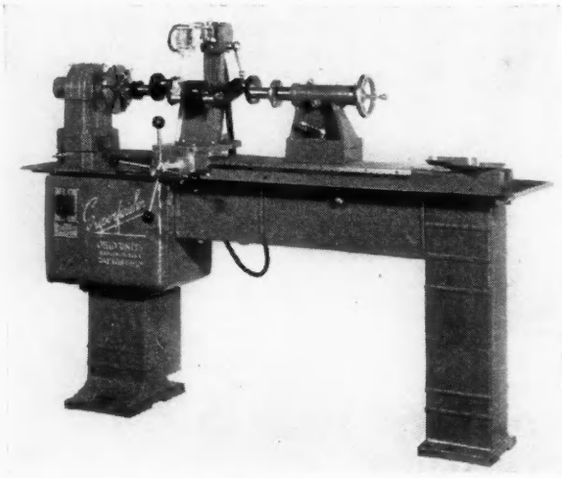
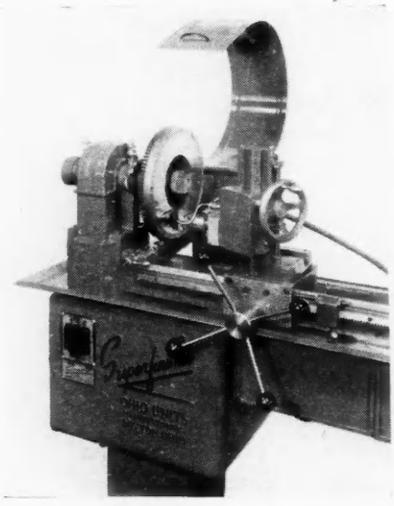
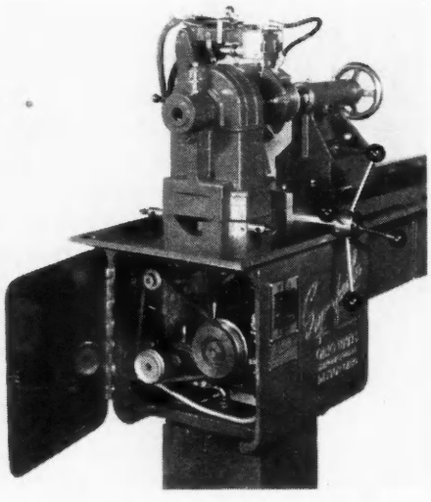


Superfinishing Crankshafts.

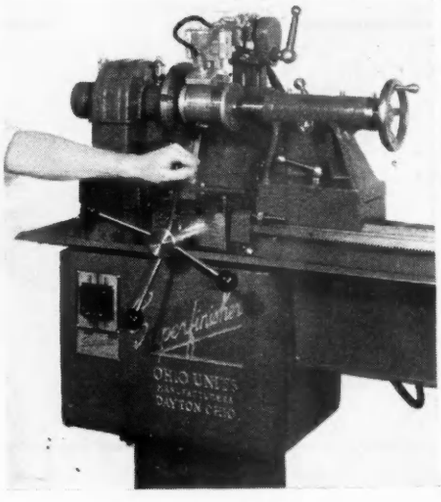
SUPERFINISHING is applicable to countless items of daily use by the metal working trades. Among these are:—Shafts, spindles, flywheel faces, clutch plates, plug gauges, reamers, valve stems, crankshafts, bushings, rolls, arbors, draw punches for shells, and shell cases, bars, valves, flat surfaces of many kinds, airplane parts, and other items too numerous to mention, including internal and external work.



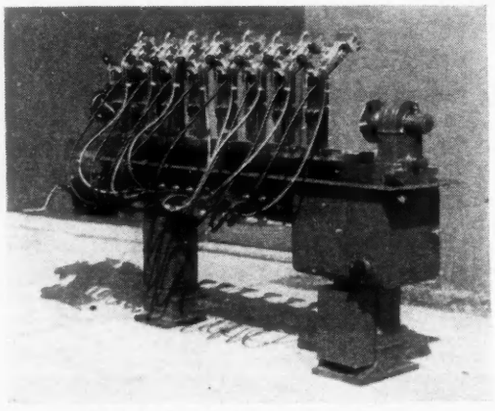
Flat Surface Finishing.



Close up showing arrangement of driving motor, pump and flexible shaft.



Round Superfinishing.



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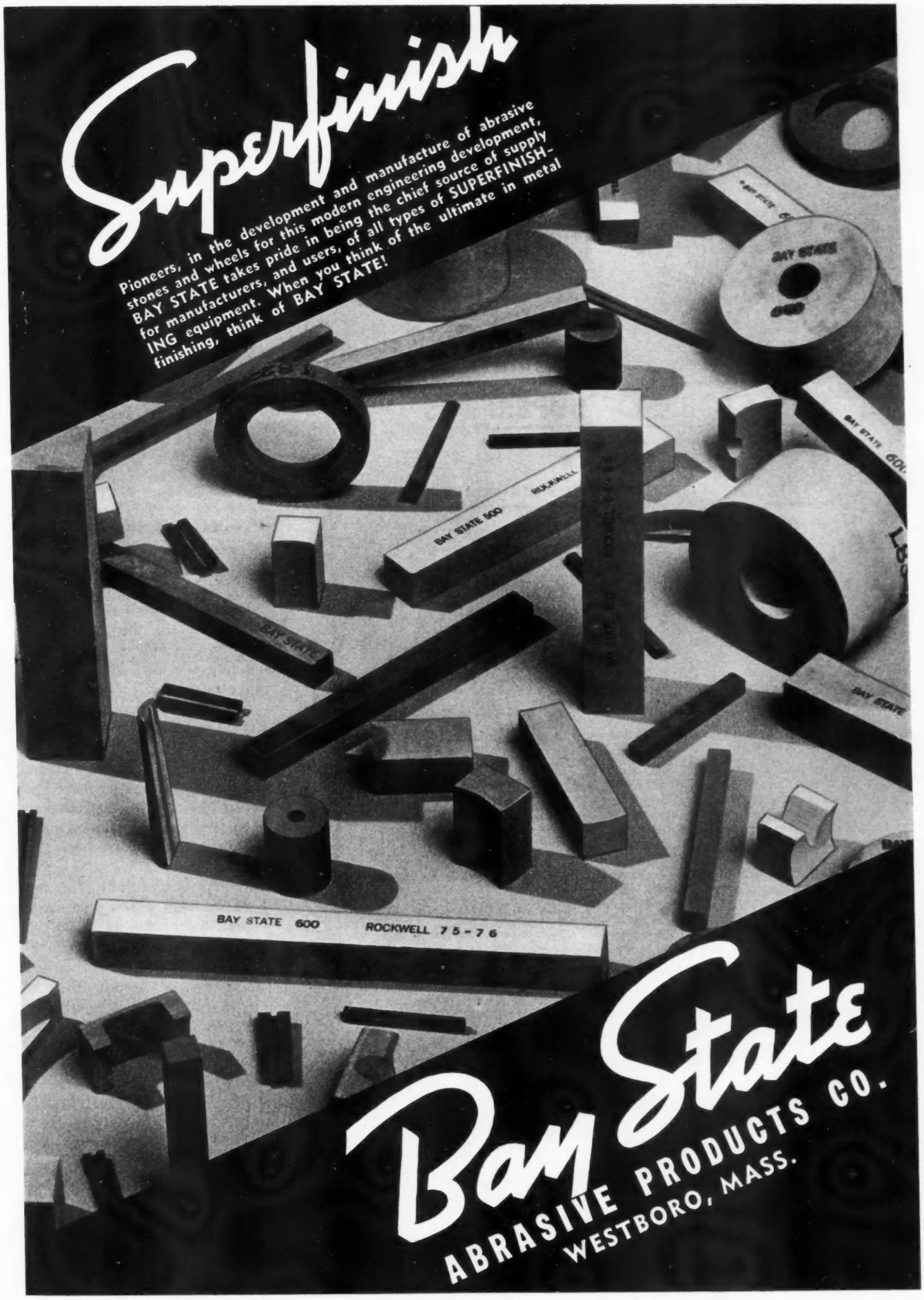
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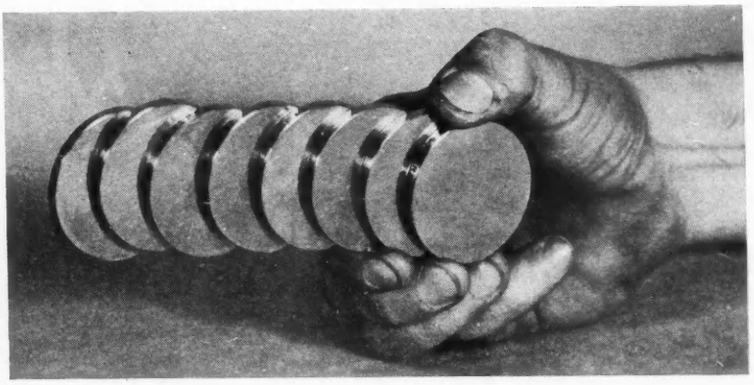

The surfaces match so perfectly that these disks form a vacuum sufficient to support the others.

Machining Functions

The object of machining, whether of the precision type or not, is to achieve certain results with respect to one or the other of two items or of a combination of both. These two items are dimension and surface.

Dimension is a function of machining for bearing purposes for clearance between parts which move relative to each other, or for the functional action of mechanical details such as the changing of reciprocating motion to rotary motion.

Surfaces are produced either for clearance between parts which move relative to each other or as bearing surfaces for rubbing, sliding or intermittent bearing action.

Precision Machining Methods

Methods of precision machining include various items of importance. Perhaps the two most important are the cost of the original equipment for machining and the cost of the resulting product.

One item which must of necessity be considered is the production quantity. The equipment available also is of importance, as this determines whether special or standard high-production machines can be used.

It is interesting to note that production machines in common use today were the special machines of only a few years ago. Different machining methods can sometimes produce practically the same results when analyzed from all standpoints, including the original equipment cost, tool cost, time for the machining operation, and the dimensional accuracy and surface quality produced.

Gages

One of the reasons for the widespread adoption of precision manufacture has been the development of suitable gage equipment. It is conceivable that years ago a lathe hand who produced one hundred parts to a

(*Turn to page 393, please*)

Every Executive Should Read

"THE STORY OF SUPERFINISH"

by Arthur M. Swigert, Jr.

The Only Complete Treatise on Machining and Precision Finishing

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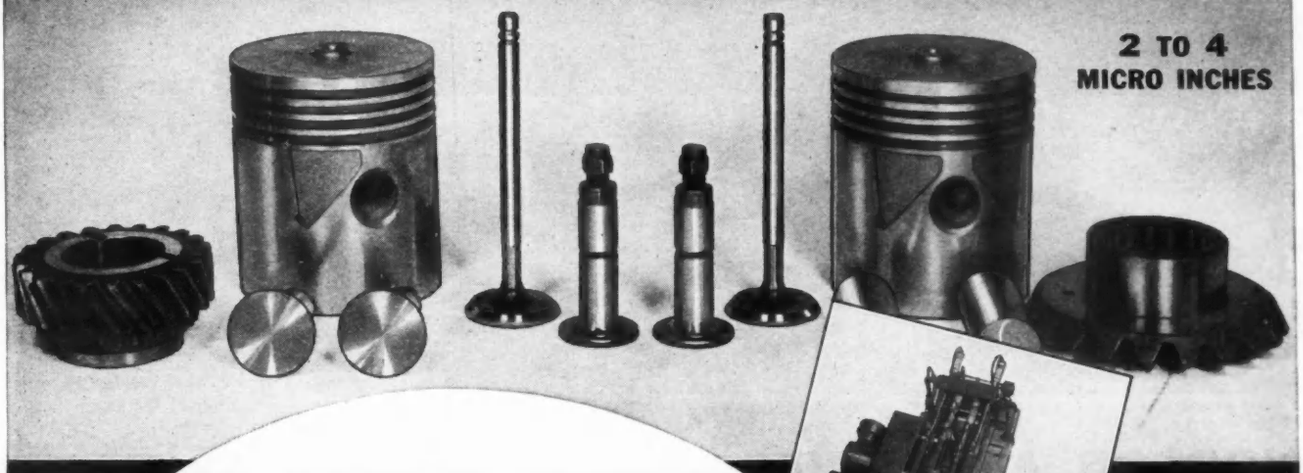
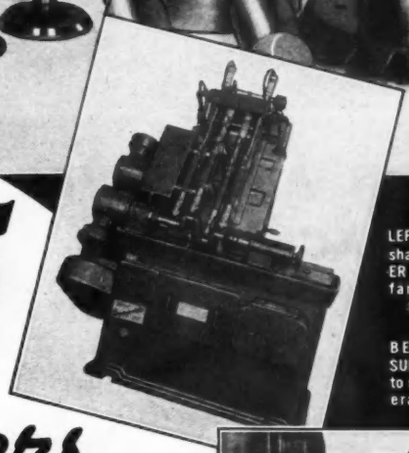


2 TO 4 MICRO INCHES

FOSTER *Superfinishers*



LEFT—Foster crankshaft SUPERFINISHER used by leading farm implement manufacturers.

BELOW—Foster SUPERFINISHER used to superfinish refrigerator crankshafts.

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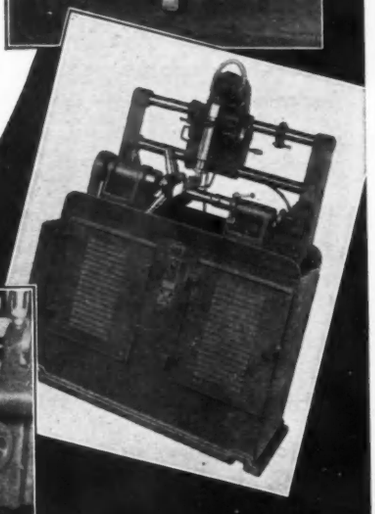
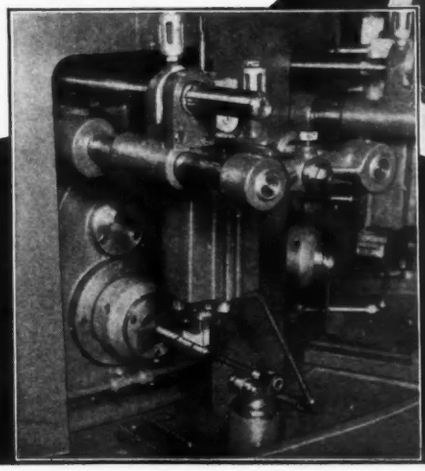
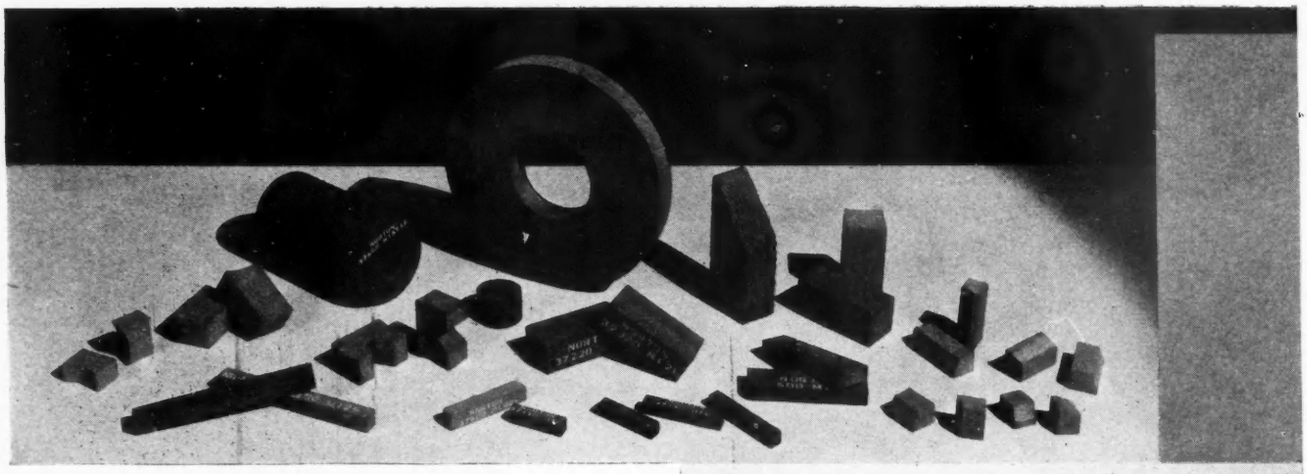


ABOVE—Foster SUPERFINISHER in Aviation plant, finishing propeller hubs.

Foster SUPERFINISHER at work on faces of automotive pressure plates.



LEFT—Superfinishing automotive distributor shafts with Foster 12 spindle SUPERFINISHER.



NORTON ABRASIVES and MACHINES *for* Precision Manufacture

HIGHLY important in precision manufacture today is the production of refined metallic surfaces. It is engaging the attention of engineers as never before. Methods and machines are studied in the light of recent scientific analysis of what actually constitutes a fine finish. Superfinishing, lapping, honing, grinding and polishing machines—all employing abrasives in some form—are producing finishes formerly obtainable only by laboratory methods.

A typical machine is the Norton No. 10-F Superfinisher, consisting principally of two heads which carry abrasive stones. The work rotates in a horizontal plane with a gyratory motion—the stones meanwhile reciprocating rapidly under pre-set adjustable pressure while simultaneously oscillating toward and away from the work center at slower frequency.

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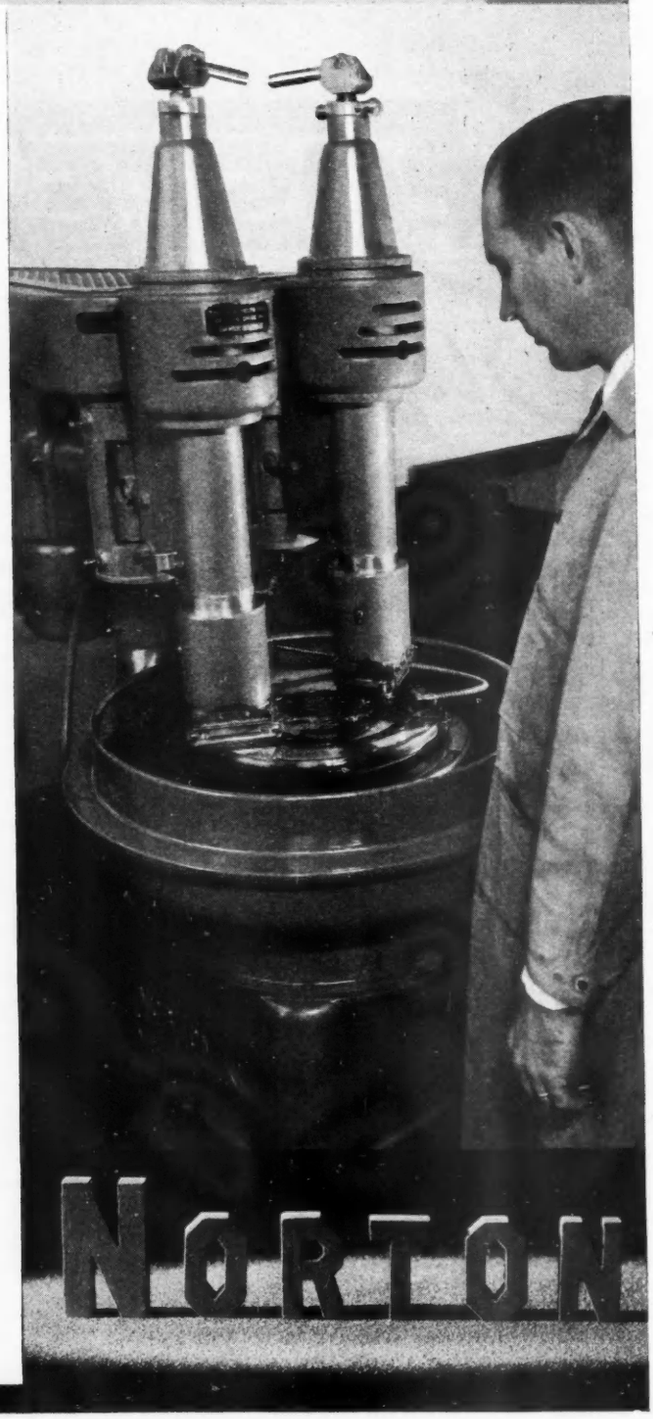

Precision Machining

(*Continued from page* 390)

scale dimension, had in this group of one hundred parts probably thirty parts with dimensions differing only by a few millionths of an inch. However, there was no way to verify this, as suitable gaging equipment was not available, and, therefore, the value of precision machining was lost.

Improvement in gages now permits the gaging of parts as to dimension by either direct measurement showing the actual size, or by comparison of one part with another.

An additional method of valuing or measuring a part is by observing its operation. If it functions suitably it may be classed as a precision-manufactured part.

The improvement in gages necessary to be able to properly check precision manufacture has to do not only with actual measurements but also with dimensions of evaluation with the surfaces produced. During the last five years many scientific measuring devices have been developed which have replaced the time-honored finger-nail method of judging surfaces.

The high plane of precision manufacture in the United States is well illustrated by reports of the operation of American-built aircraft in foreign countries. It has been reported that less upkeep and repairs are required by American-built equipment than by corresponding equipment produced in any other country. Less time and trouble is involved in servicing, dismantling and repairing such equipment.

Machining Cycles

History teaches that practically everything follows more or less well-defined cycles. This applies to styles, habits, methods, processes and many other items.

Perhaps the most outstanding cycles through which all human efforts pass are those of successive "boom" times and depressions. It has been said that in times of depression the greatest strides are made in all arts. During boom times individuals and organizations are kept busy producing what may be termed standard equipment and following standard methods. This does not appear to allow time for the development or exploitation of new or radically different ideas.

It is at the boom stage of the cycle that the machine tool industry at present finds itself. Machine-tool builders are turning out equipment designed primarily to produce dimensional accuracy. Some stress, of course, is placed also on the refinement of surfaces, yet not to the degree that this refinement will be developed in the future.

After the present period of turning out of dimension-producing machines in great numbers has passed—as all such periods will—the need for such machines will decrease. More time and thought will then be given to surface-finishing methods, not only with respect to production but also with respect to their measurement and use.

All of the machine tool equipment being built at present, whether primarily for dimension-forming or surface-finishing, or a combination of both, will not change the basic problem.

It may also be noted that the bulk of the new machine-tool equipment being built is being utilized by relatively few large concerns. A great number of small manufacturing concerns will not be benefitted by this equipment and must continue to rely upon equipment which has been in use a great many years. Therefore, users of old, relatively inaccurate manufacturing equipment should have available finish-machining methods which will tend to improve dimensional accuracy and, at the same time, provide high-quality surfaces. This will be accomplished not by reducing the field for all new machines but by actually enlarging the field as the demand for better finishes increases.

The influence of precision manufacture on all industries is exemplified by the steady rise of the motor-car industry. Since the conception of motorcar manufacture the various cycles have been primarily as follows:

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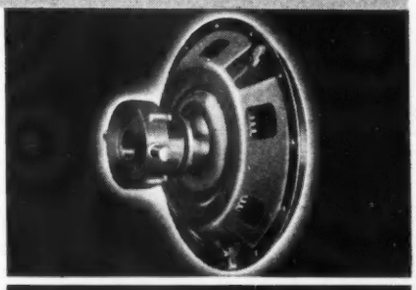

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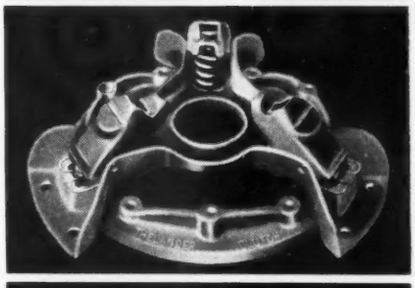
—for light to heavy-duty service on crawler or wheel-type tractors, trucks, tanks, passenger cars, etc. 13 improved features, including cushioned engagement, turbulent ventilating action, minimized pedal pressure, reduction of friction and pivot point deflection. 25% less weight, 30% fewer parts.



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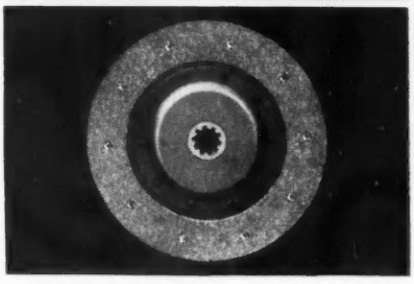

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Running Ability—The early motor-car manufacturer and purchaser were concerned primarily with the running ability of the vehicle.

Starting Ability—This was of great importance to the early manufacturer and purchaser, as it to a large extent determined the usefulness of the product. It is easy to see that without the improvement in starting ability use of the motor car would be greatly curtailed.

Dependability—Later, both the manufacturer and purchaser became interested primarily in the dependability of the automobile.

Roadability—Still later the riding quality or roadability of the car became of increasing importance.

Eye Appeal—As development in all of the above items approached the zenith, and a certain level in respect to them was taken for granted, eye-appeal became of most importance to manufacturers and users.

That all of the foregoing items could be taken for granted was due primarily to precision machining both for dimension and for surface finishing. This practice allowed manufacturers and designers to stress the appearance of the product without having to seriously consider any of the other problems, which had been already solved.

Fuller

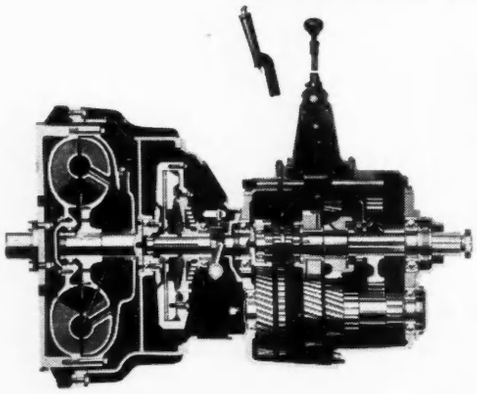
Hydraulic Coupled FULLER Transmissions in a fleet of 24 trucks have licked this tough hauling job in the open pit iron mines of Minnesota.

With these transmissions the driver shifts into the most suitable ratio for the 8 to 10% grade, starts his 64,000 lb. load and travels the entire mile from shovel to tipple at a 10-mile-per-hour speed without further shifting! The engine cannot be stalled by wheel resistance. Torsional vibration and shock loads are eliminated, reducing wear and tear on motor, clutch, drive shaft and differential.

These operating advantages, coupled with high efficiency in the hydraulic coupling, have speeded up hauling and sharply reduced hauling costs.

For interested engineers and fleet operators, Fuller has prepared an illustrated pamphlet describing the combinations of Fuller Transmissions and Hydraulic Couplings. Write for a copy.

FULLER MFG. CO., *Kalamazoo, Mich.*



FULLER
Transmission with
Hydraulic Couplings

Advancement in Civilization

The importance of metallurgy and mechanical devices as factors in civilization can be realized when considering the successive steps in three lines of activity outlined below:

Transportation	Lighting	Farming
Walk	Sun	Hand
Float	Moon	Fork Stick
Wagon	Wick	Ox
Bicycle	Candle	Horse
Train	Kerosene	Steel Plow
Auto	Pressure	Reaper
Plane	Gas Jet	Tractor
Rocket	Gas Burner	Combine
	Electric Bulb	
	Electric Tube	

Perhaps no era has produced a more concrete example of the importance of precision surfaces than the present one. With practically every individual in the world affected by warfare in some way or other, it is interesting to review the various stages that led up to the use of present mechanized equipment. Land warfare has progressed through the following stages:

Swords were first used for hand-to-hand combat.

Later armor was built by which the individual was protected.

Spears were developed sufficiently heavy to pierce the armor then available.

Arrows were introduced and enabled a combatant to attack an opponent at some distance.

Chariots were later developed and may be said to have been the forerunners of present-day armored tank equipment.

With the development of gun powder the transition from hand-to-hand fighting to fighting at a distance was completed.

The development of materials for warfare now appears to be as follows:

For warfare on land, mobile units such as armored cars, tanks and various types of rapid fire gun equipment are used.

For warfare on water, armored battleships, submarines and radio-controlled torpedoes are available.

For warfare in the air, fast pursuit planes and giant bombers with various types of bombs are used.

In the future we may expect to see small planes or flying torpedoes which will be directed to either *follow* planes, *meet* planes head on, or intercept planes at any angle. They will be guided through either radio control from some distant point or through the use of steering devices actuated by the noise of the plane which is the target.

Here again can be seen a cycle of development as it pertains to warfare.

In ancient times, all lands were drained of man power who for years would form huge battle camps on opposite sides of a river or besiege a walled city. Finally they would engage in battle, in a man-to-man struggle, and sometimes only a few soldiers would be left of vast armies.

It is conceivable that ultimately each continent will be one vast manufacturing plant for the production of imple-

ments of destruction which in some form will be directed at an opposing continent by one man in a control tower miles in the air.

Both the manufacturing industry and the machine tool industry must realize that during the present defense program machine-tool equipment and, therefore, productive capacity is being increased at many times the normal rate. This will ultimately lead to a problem of finding outlets for products manufactured for different purposes than that for which the equipment and plant facilities are now being built.

As most of the equipment now being manufactured is designed primarily for the dimensional phase of manufacture, we may well expect that during the next stage of the cycle effort will be concentrated on the development and refinement of surface-finishing equipment. In this way both the large and small user of machine-tool equipment, whether old or new, can obtain a greater percentage of benefits arising from the precision manufacture of mechanical products.

Precision Machining Methods

Turning is acknowledged to be the oldest mechanical method of producing surface finishes. It is interesting to review the progress of turning equipment through the years.

Lathe equipment developed relatively slowly until about the turn of this century. From that time on, development was very rapid, due principally to the great improvement in tool steels. This improvement necessitated the development of turning equipment that would stand the higher speeds and greater cuts which the new tool steels allowed. Improvements in machines and in tools have since gone hand in hand, until today the lathe user has available equipment that combines many advantages.

It might be pointed out that lathe manufacturers, in common with other machine-tool builders, are in what may be termed a *beneficient circle*. That is, a development in tools allows heavier cuts to be taken at higher surface speeds, which allows harder, tougher material to be machined, which requires heavier, more rigid machines, which again allows better tools or more efficient use of tools, and so on. That is progress.

Turning of metal with single-point tools is probably the machining method at present most widely used. Turning is a reducing operation in which the part is dimensionally changed, either for clearance in assembly, or to break down the surface preparatory to other reducing operations which will leave the surface smoother.

By the tool method of producing surface finishes material is removed until a definite dimensional size, a definite degree of smoothness, or a suitable combination of both is obtained. Tools may be of single-point type, such as are used in lathes, shapers, or planers, or they may be of the multiple-cutter type, such as inserted-blade milling cutters. Finally tools may be special in shape, such as forming tools and broaches.

For many centuries, man used the natural abrasives, emery and sandstone, for the many abrading or sharpening operations necessary to keep his crude implements in condition. As these natural abrasives were not sufficiently uniform for mass-production operations, synthetic abrasives were introduced around the year 1890. Since that time great strides have been made by the abrasive manufacturers in producing synthetic types of grinding wheels. Machine tool builders specializing in grinding equipment have built into their machines features which obtain maximum performance from these abrasive wheels. The manufacturers of the various types of bonded synthetic abrasive wheels deserve credit for having helped to develop a method of producing better surfaces. This has been of tremendous benefit to all industry.

Every mechanic concerned with producing surface finish with abrasives understands the terms "snag grinding," "rough grinding," and "finish grinding." These surface finishing methods refer to different phases of the same process, and produce different qualities of the same type of surface.

During the development of synthetic

From the DeWitt Clinton to Atlantic Clipper

Contrast the DeWitt Clinton's 10-mile-per-hour gait with the daily 23-hour Atlantic Clipper New York-to-Lisbon flights. What a dramatic example of the great strides made by transportation!

The year-by-year improvements in the machine tools manufactured by LeBlond are not in themselves as dramatic. But the DeWitt Clinton and Atlantic Clipper . . . and all forms of transportation in between . . . on land, sea, and in the air . . . are dramatic evidence of the contribution LeBlond machine tools have made to the transportation industry. For there never would have been an Atlantic Clipper, or even an "iron horse," had there not been turning equipment to produce these conveyances cheaper and better year after year.

THE R. K. LeBLOND MACHINE TOOL CO.
CINCINNATI, OHIO

abrasive materials there has been constant improvement in the technique of utilizing abrasives. It may be a fast stock removing process, a surface finishing process or, in some operations where the finest surface finish is not required, a combination of both dimension-producing and surface-finishing technique.

With the development of bonded synthetic abrasives it has been found that different applications other than wheel grinding can be used. These are methods of producing surface finish by high speed and pressure application of bonded abrasives with surface contact and, for some operations, line-contact. The line-contact application is utilized in different methods—one by application of the wheel face and others by the application of the wheel side or disk face.

Loose abrasives bonded to paper or cloth can be applied to the work in much the same manner as bonded abrasives.

Loose abrasive is also charged into or placed onto non-metallic disks and applied to surfaces of round or flat parts with line-contact on round parts and surface contact on flat parts.

All of the above are mechanical methods of producing surface finish. The type of surface produced, in respect to smoothness, accuracy and metallic structure, may vary considerably, however, from one method to another. Some of these methods have taken the name of various processes which in the past have been emblematic of fine surfaces.

Superfinishing Method of Surface Finishing

The surface-finishing problem has been analyzed from the standpoint that in the machining of parts we may have three major objectives in view:

First to produce a dimension.

Second, to produce a finish.

Third, to produce a dimension and a finish simultaneously.

That producing dimension and finish at the same time is a problem is apparent from the fact that severe machining methods used in producing dimensions disrupt surface layers of metal to a considerable depth, and are unable to remove these layers of metal, so as to reach the undisturbed crystalline structure beneath, without continually reproducing more fragmented and/or smear metal.

As various machining methods are analyzed it is noticeable that the less severe the cutting action of the process, the less the depth of the disturbed condition.

Advance in Machine Surfacing Equipment

To a great many people the old phrase, "There is nothing new under the sun," appears to be a statement of fact. However, a resume of machine methods of surface finishing shows that there is constant improvement.

At one time the turning method was the only commercially available method of producing dimensional and surface finish.

Grinding was a later development in which a surface that had been previously produced by turning could be made more accurate and with a smoother surface than by turning. The development of grinding proved that, while turning had been an acceptable practice, a new technique which could produce smoother surfaces had a definite place in industry.

For a time the degree of dimensional accuracy and the surfaces produced by grinding became the accepted practice. Then processes of refined grinding, such as honing and machine lapping, began to show merit. Within the fields where they operated best they became accepted methods of producing surface and dimension. Finally, "superfinishing" was developed. The technique of this process has influenced all types and methods of machining.

Dimensional Accuracy

Preparing a surface for superfinishing requires that the final dimensional accuracy should be maintained as closely as possible in the preparatory operation. This does not mean that dimensional inaccuracies will not be improved by superfinishing, but it does mean that the closer the accuracy of the preliminary operation the more

accurate will be the resulting surface.

It will be found less expensive to correct the causes of dimensional inaccuracies in the preliminary operations than in the superfinishing process.

It is interesting to observe that practically every installation of superfinishing equipment has revealed dimensional defects resulting from previous operations. These were defects which no present-day commercial method of gaging would ever find. They have included out-of-round, high and low spots, chatter, surface defects, and other like conditions.

If dimensional irregularities of any magnitude are produced in the operation previous to superfinishing, the correcting of this condition by superfinishing will naturally increase the time needed for final surface finishing. The maximum operating efficiency of superfinishing requires that previous operations should be uniform and dimensionally accurate. If the surfaces are not dimensionally accurate, superfinishing will immediately show up the dimensional irregularities, as the higher areas will be removed first. This self-inspection feature has been of much benefit to users of superfinishing.

This disclosure of defects from previous operations does not mean that the previous operations should be condemned or that present equipment should be scrapped. The inspection "faculty" of superfinish merely reinforces the plant's regular inspection. It only means that more care should be exercised in carrying out previous operations, and that the maintenance of equipment should perhaps be put on a higher plane.

The combined result, namely, production of more accurate dimensional surfaces as well as smoother surfaces, by the use of superfinishing technique, is of inestimable value.

It should be pointed out that the introduction of a new and different technique in mechanically-producing surfaces has never reacted unfavorably on older, less-refined machining methods. In all cases the mechanical improvement which finer surfaces have permitted has so advanced civilization that a demand has been created for wider use of all machine tools.

With each mechanical innovation the persons who believe there is nothing new under the sun have their counterpart in another group of persons who have to be shown. These groups act as a balance wheel for the more aggressive type of individuals. When members of these groups are shown something new and are satisfied there is improvement, it is overwhelming proof that the improvements suggested or put into practice actually have merit.

Superfinish has successfully followed this procedure.

Competition makes for progress, which is the reason practically all machining methods can or have become precision methods. The first turning operations using single-point tools produced parts which were rough in dimension and rough in surface finish. Due primarily to tool steel development, however, the single-point turning method can now be said to be one of the most accurate for precision work, both for dimension and for surface finish.

In the past grinding was used primarily in snagging operations and for sharpening edge tools. Due to development of abrasive (tools), grinding is now universally used, not only for precision work, but also for fine surface finishing.

The above turning and grinding methods have been the basis for all precision manufacture from a dimensional standpoint for many years. It has only been recently that refined surface finishing methods, as exemplified by superfinishing, have obtained wide use not only for dimensional accuracy, but also for surface finishing.

In this discussion no attempt has been made to supply a technical consideration of the advantages or disadvantages of precision manufacture, whether for dimension-forming operations or surface-forming operations. It must always be remembered that the usefulness of mechanical products has increased in direct proportion to the increase in precision manufacture, whether for dimensional accuracy or refined surface finish.

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Your Constant Guarantee of Accuracy
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CLEVELAND, OHIO 1745 ROCKWELL AVENUE
MILWAUKEE, WIS. 513 EAST BUFFALO ST.
DAYTON, OHIO 990 E. MONUMENT AVE.
DUCOMMUN Metals and Supply Co. Los Angeles—San Francisco
23,000,000 stampings have been made in this die mounted in a Danly Precision Die Set
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DANLY DIE SETS and DIE MAKERS' SUPPLIES

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE INDUSTRIES**

Further broadening of general business activity is evident. The New York *Times* seasonally adjusted index for the first week of September rose to 105.8 per cent of the estimated normal, as compared with 104.3 a fortnight earlier and 97.2 a year ago. The drop in the unadjusted index of *The Journal of Commerce* to 101.6 per cent of the 1927-29 average from 108.4 for the final week of August reflected the influence of a holiday.

The Federal Reserve adjusted index of industrial production for August stands at a preliminary figure of 123, as against 121 for each of the two preceding months.

Retail trade maintained an accelerated pace the first week; regional averages, according to Dun & Bradstreet estimates, were from five to 10 per cent above corresponding 1939 sales. Department store sales during the week ended Sept. 7 were 11 per cent above the comparable total last year, according to the Federal Reserve compilation.

Production of electricity by the power and light industry increased less than seasonally the first week; the gain over output a year ago was 7.9 per cent, as against 7.5 per cent for the week before.

The movement of railway freight during the first week of September, affected by holiday observance, recorded a drop of 9.6 per cent from the year's peak thus far; but the number of cars loaded, 695,258, was five per cent more than the comparable 1939 figure.

Bank debits to other than interbank accounts in leading cities during the 13-week period ended Sept. 11 were one per cent less than the corresponding amount last year.

Crude oil production during the second week of September increased slightly to an average of 3,647,400 barrels daily and was 23,100 barrels more than the required output as computed by the Bureau of Mines.

Engineering construction contracts awarded during the week ended Sept. 12 were 36 per cent above the comparable amount a year ago, according to *Engineering News-Record*. Total contracts in 37 States during August, $414,941,000, as reported by F. W. Dodge Corp., exceeded any other monthly amount since June, 1930, and were 33 per cent above that a year ago.

Cotton-mill activity declined more than seasonally in the week ended Sept. 7. The New York *Times* adjusted index was 133.5, as against 138.4 for the week before and 129.4 a year ago.

Business failures during the week ended Sept. 12 totaled 249, as compared with 177 in the preceding week and 269 a year ago, according to the Dun & Bradstreet report.

Professor Fisher's index of wholesale commodity prices declined last week to 81.8 per cent of the 1926 average from 82.0, as compared with 81.0 for the third week of August, the low for the year to date.

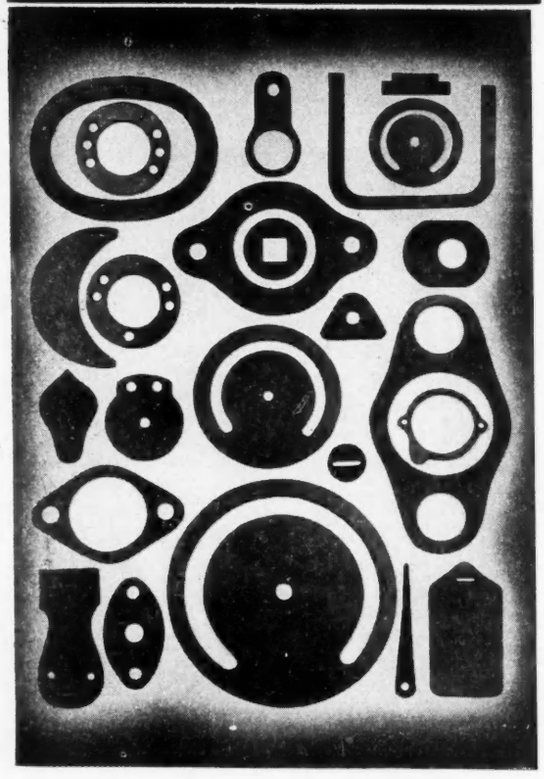
Excess reserves of the member banks of the Federal Reserve system rose $50,000,000 during the week ended Sept. 11 to an estimated total of $6,540,000,000. Business loans of the reporting members increased $91,000,000 and stood $412,000,000 above the total a year ago.

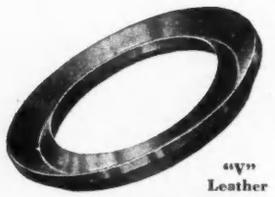
K-L BRAND LEATHER WASHERS

Hydraulic Packings

and MECHANICAL LEATHERS

NOTHING TAKES THE PLACE OF Leather





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ROCKFORD, ILLINOIS

Defense Activities

(*Continued from page* 374)

to the present factory will add 500,000 of the 800,000 sq. ft. of floor space necessary. The aircraft program will employ 14,000 workers and the first engines are expected to be ready by July, 1941.

The British order amounts to $125,000,000 and with optional orders for 10,000 more engines for the British and 5000 more for the U. S., the total will reach $350,000,000, according to M. M. Gilman, president.

Four General Motors plants will be used for the manufacture of machine guns for the government, it was announced Sept. 14 by C. E. Wilson, president. The contract amounts to

$20,000,000 for equipment and $61,398,872 for the guns. The plants to engage in this work will be the Saginaw Steering Gear Division, Saginaw; AC Spark Plug Division, Flint; Frigidaire Division, Dayton, Ohio, and Guide Lamp Division, Syracuse, N. Y. Trained personnel with experience in both precision and quantity manufacture is available at those plants.

"The War Department in April, 1938, asked General Motors to make a study of the possibility of manufacturing these guns," said Mr. Wilson. "This study has been going on at the Saginaw Steering Gear Division since that time. An educational order for 500 guns was placed with this division on May 29, 1940."

Some additions to present facilities will be required and work on these will be begun immediately. AC Spark Plug will transfer its automotive operations to two new buildings to be added to its Dort Highway development in Flint and take over the Industrial Avenue plant for machine gun work.

Continental Motors Corp. received two government orders totaling $12,782,311 for automotive engines, increasing its national defense orders to $17,112,000. This will boost employment to 4100 workers at the corporation's Muskegon plant.

Other new Michigan orders include $3,352,336 to Chevrolet for trucks; $143,824 to Hudson Motor Car Co. for ammunition components; $1,891,962 to Budd Wheel Co. for ammunition components, and $234,562 to Saginaw Stamping & Tool Co. for gun trailers; $12,491,797 to Yellowtruck & Coach Mfg. Co. for trucks; $3,784,364 to Garwood Industries for artillery material; $834,599 to Timken Detroit Axle for artillery material; $4,780,591 to Fargo Motor Corp. for trucks; $1,653,750 to Auto Specialties Mfg. Co., St. Joseph, Mich., for ammunition components; $161,250 to Thorrez & Maes Mfg. Co., Jackson, for ammunition components; $281,800 to Reo Motors for trucks; and $6,100,000 to Duplex Printing Press Co., Battle Creek, for gun carriages.

The Stinson aircraft plant at Wayne, Mich., will reopen within the next three months to manufacture two models of light commercial aircraft. Last April the Stinson Aircraft Division of the Aviation Manufacturing Corp. was moved from Wayne to Nashville, Tenn., in accordance with a government program of shifting the aircraft industry inland. In August the Stinson Division as well as the Barkley-Grow Aircraft Corp., of Detroit, became parts of Vultee Aircraft, Inc., as the result of a merger. The personnel of the Barkley-Grow plant now will move into the Stinson plant at Wayne, employing 300 or 400 men, while the Nashville Stinson plant will concentrate on military aircraft.

Our Third "Oscar"

AN award of merit for editorial achievement was presented to AUTOMOTIVE INDUSTRIES on Sept. 19 by the publication *Industrial Marketing*, for the series of articles on details of design and manufacture of automotive vehicles and parts which have been a feature of the first issues of the month for several years. The current series, prepared largely by Joseph Geschelin, Detroit technical editor, is represented in this issue by an article titled "Quality Control Sets Production Pace." The award is the third consecutive one received by AUTOMOTIVE INDUSTRIES in the international competition begun by *Industrial Marketing* in 1938.

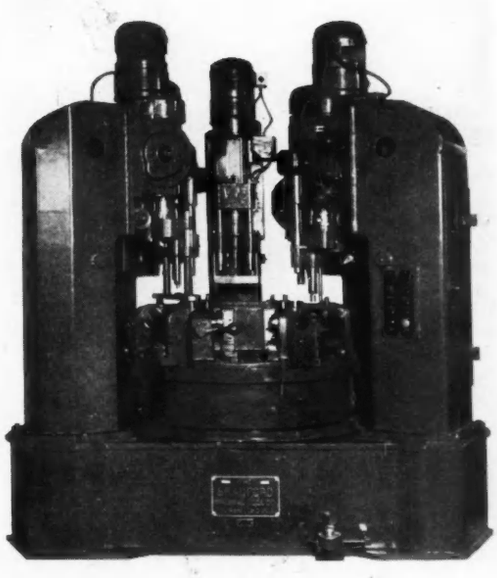
40 YEARS AGO

Most of our foreign contemporaries are at present devoting considerable space to reports of tests of military automobiles and to opinions of military experts on the probable future use of this vehicle in military operations . . . it seems that the tire question is one of the most important problems in connection with the adaptation of mechanical motive power to military vehicles.

From *The Horseless Age*, October, 1900.

BRADFORD MACHINE TOOLS

TRIED and PROVEN in SERVICE



One of the oldest machine tool manufacturers in the country, BRADFORD was among the first to produce the unit type head for operations such as drilling, reaming, tapping, spot-facing and hollow-milling. Developed to meet present-day high-speed production demands, these units have been designed for assembling one or more, at any angle from Horizontal to Vertical, into a single machine.

The heads are made in two general types, a light-duty high-speed head for small work and a heavy-duty medium and slow-speed head for large work. The light-duty units, of completely anti-friction construction, have maximum spindle speeds of 6000 r.p.m. to accommodate small tools in materials such as brass or aluminum. Large units have speeds up to 2500 r.p.m. These units are of combined anti-friction and bronze bearing construction.

Shown here is the BRADFORD Vertical 5-Unit Machine with 6-Foot Index Table.

OPERATIONS

1st Pos.—Load
2nd Pos.—Drill 13/64 and 25/64 Dia.
3rd Pos.—Drill 23/64
4th Pos.—Spotface and co sink 7/8 and 9/16 Dia.
5th Pos.—Ream 3/8 Dia.
6th Pos.—Tap 7/16-20 and 1/4-20 Thd.
1440 Operations per hour

Automatic and semi-automatic machines employing BRADFORD Unit Type Heads can be furnished for performing a wide variety of precision operations. Our engineering laboratories stand ready to consider your production problems.

BRADFORD MACHINE TOOL CO.

657-671 Evans St., Cincinnati, Ohio

Also manufacturers of High Grade Engine Lathes

(Dealers Wanted for some territories)

War Dept. Sends Speed-Up Letters To Manufacturers

Aircraft Builders Instructed To Tool-Up Without Delay While Formal Contracts Are Being Completed

Approved by the National Defense Advisory Commission, the War Department has sent speed-up letters to 21 manufacturers of airplanes, engines, propellers and blades, authorizing them to go forward with the procurement of the necessary jigs, dies, tools, fixtures, material and equipment for the Department's $1,250,000,000 aircraft program. The letters will enable manufacturers to proceed without delay while unsettled details of formal contracts are being completed.

To expedite output the War Department program provides for type standardization to insure mass production of aircraft. The planes will be virtual duplicates of models already being made for the Army. Hence a majority of the planes in the new program can be obtained merely by exercising options in some existing contracts. The remainder will be secured under other contracts.

The letters were sent immediately after the President signed the $5,250,000,000 second supplemental defense appropriation bill on Tuesday of last week. The measure provides for 14,394 airplanes, 28,282 engines and propellers and blades. The approximate costs of the airplanes and engines are $817,000,000 and $377,000,000 respectively. The estimated cost of the propellers and blades is $57,000,000.

Letters were sent to the following:

Airplanes

Boeing Aircraft Co., Seattle; Consolidated Aircraft Corp., San Diego, Cal.; Glenn L. Martin Co., Baltimore; North American Aviation, Inc., Inglewood, Cal.; Douglas Aircraft Co., Inc., Santa Monica, Cal.; Lockheed Aircraft Corp., Burbank, Cal.; Bell Aircraft Corp., Buffalo; Curtiss Aeroplane Division, Curtiss-Wright Corp., Buffalo; St. Louis Airplane Division, Curtiss-Wright Corp., Robertson, Mo.; Republic Aviation Corp., Farmingdale, L. I., New York; Beech Aircraft Corp., Wichita, Kan.; Vultee Aircraft, Inc., Downey, Cal.; Fairchild Aircraft Division, Fairchild Engine & Airplane Corp., Hagerstown, Md.; Ryan Aeronautical Co., San Diego, Cal.; Stearman Aircraft Division, Boeing Airplane Co., Wichita, Kan.

Engines

Ford Motor Co., Dearborn, Mich.; Continental Motors Corp., Muskegon, Mich.; Lycoming Division, Aviation Mfg. Corp., Williamsport, Pa.; Allison Engineering Co., Division of General Motors Corp., Indianapolis; Wright Aeronautical Corp., Paterson, N. J.

Propellers and Blades

Curtiss Propeller Division, Curtiss-Wright Corp., Clifton, N. J.

A War Department official said that by purchasing from plants that already are engaged in production for it, the Army obtains these advantages: (1) A saving of 60 to 90 days in advertising for and opening bids; (2) tests of new models will be unnecessary; (3) use of same plants, tools and experienced personnel in plants now producing Army aircraft; (4) mass production can proceed with assurance of larger orders and standard types without interruption of production line by new models.

War Dept. Will Make Use Of Safety Foundation Services

The War Department has announced that arrangements are being made to utilize the services of the Automotive

STEEL *for the Cars and Trucks of Tomorrow*

LONG BEFORE America's automobiles roll off the assembly line, long before they meet the public in the showroom or on the highway, many of the steels for their crankshafts, axles, camshafts, connecting rods, and gears are in production at Wisconsin Steel. Here the mill and the laboratory work together with one aim: the *right* steel for the *specified* job.

Supplying high quality steels to automotive manufacturers is a service we hold in deep regard. The quality of these steels is assured by careful selection of materials, precision manufacture, and rigid inspection. Write or phone us about your steel problems. We are well equipped to make a wide variety of alloy and carbon steels, exactly to your specifications.

WISCONSIN STEEL COMPANY
General Offices:
180 North Michigan Avenue, Chicago, Illinois
Affiliate of International Harvester Company

WISCONSIN STEEL

Safety Foundation which, the Department said, "were generously tendered" by Paul G. Hoffman, president of the organization, in studying traffic control problems in connection with military movements. A number of conferences have been held at which Army officers and some of the country's leading traffic control experts were present. Among the subjects discussed were traffic engineering, training of traffic military police and driver training and fleet operation.

Civilian traffic control experts, associated with the Automotive Foundation, attended some of the Army maneuvers held during August and are planning to submit reports and recommendations based on their observations of Army motor transport movements. Among the observers at these maneuvers were Sidney J. Williams, Director, Public Safety Division, National Safety Council; Dr. Miller McClintock, Director, Yale Bureau for Street Traffic Research; Lieutenant Franklin M. Kreml, Director, Safety Division, International Association of Chiefs of Police; Burton W. Marsh, Director, Safety and Traffic Engineering Department, American Automobile Association, and Reynolds Weaver, Assistant to Director, Automotive Safety Foundation, all of whom attended the recent New York, Louisiana and Wisconsin maneuvers to observe traffic movements. The facilities and personnel of the organizations represented by these individuals have been offered, as well as special facilities for research into traffic control and congestion problems.

Fleet engineering methods and driver training practices of large fleet operators will also be made available through the American Trucking Associations, Inc., and the National Association of Motor Bus Operators.

Federal Requisitioning Of Private Plants Authorized

President Roosevelt on Sept. 16 signed the selective training and service bill which included a rewritten provision authorizing the government to take over essential plants under certain conditions.

Section 9 of the act, relating to the requisition of private plants for enforcing the acceptance of and compliance with government defense orders, stipulates that:

1. Compliance with orders for defense products placed in the President through the War or Navy Departments by a company equipped to supply such products is obligatory and such orders must take precedence over all other pending contracts and orders.

2. In the event the management of any plant refuses to supply ordered material or refuses to give it precedence over all other work, the President through the War and Navy Department is authorized to take immediate possession of and operate any plant which in the opinion of the Secretary of War or the Secretary of the Navy is capable of being readily transformed for the manufacture of arms or ammunition, parts thereof, or other essential equipment.

3. The government is also authorized to take possession of such a plant if in supplying essential defense equipment the company involved charges more than a reasonable price, as determined by the War and Navy Departments.

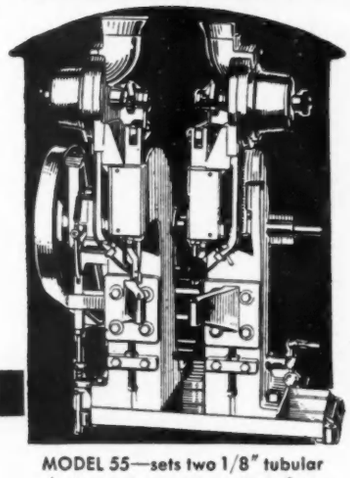
4. Violation of these provisions is deemed to be a felony punishable upon conviction by not more than three years imprisonment and fine of not more than $50,000.

5. Compensation to be paid for any plant taken over by the government shall be "fair and just." (Any owner dissatisfied with the rental awarded could sue the government for the balance claimed.)

The act limits the number of men in training at one time to 900,000 and sets the ages for compulsory registration at 21 to 36 years. After registration, local draft boards will classify the registrants as (1) immediately available for service; (2) deferred because of the importance of his service to the country; (3) deferred because of dependents; and (4) deferred because his service is undesirable for moral or other reasons.

"WE'VE PUT OUR RIVETING JOBS ON A MASS PRODUCTION SCHEDULE WITH MULTIPLE SETTERS"

"Cost of finished assemblies was a big problem in our plant until we tried Chicago double rivet setters. We now get all the advantages of lower cost through mass production methods. Furthermore, the feature of adjustable riveting centers of our Chicago equipment practically eliminates the need for buying new riveting units every time slight changes are made in product design."



MODEL 55—sets two 1/8" tubular rivets at once on centers from 7/16" to 7". Larger models available. Bench and pedestal types.

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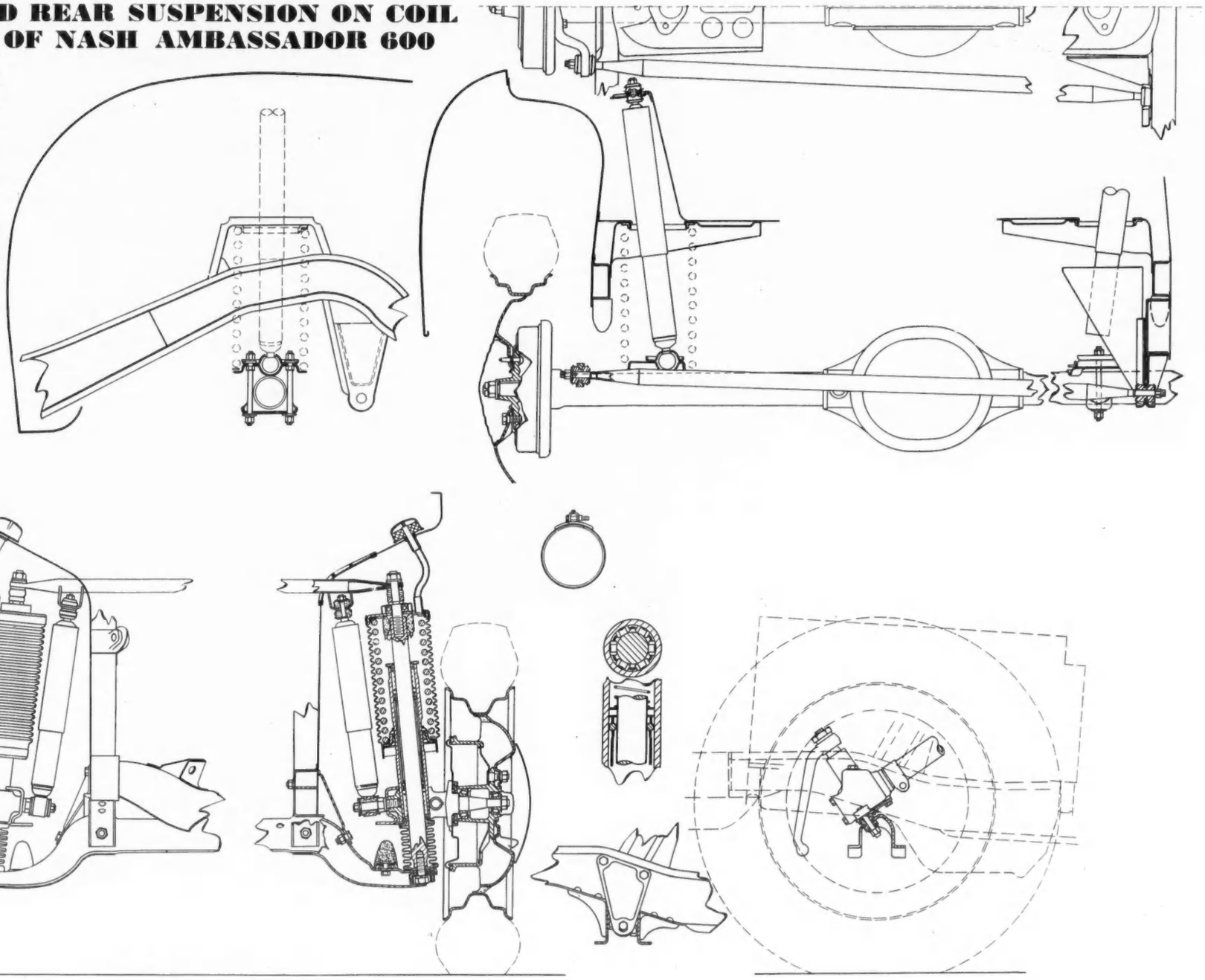
Learn about the production of this money-saving machine in your own shop. No obligation.

Chicago RIVET & MACHINE CO.

1862 So. 54th Ave. (Cicero P. O.) Chicago, Ill.

FRONT AND REAR SUSPENSION ON COIL SPRINGS OF NASH AMBASSADOR 600

In the upper half of the page are shown three views of the rear suspension together with direct-acting shock absorber and stabilizer bar. In the lower half, the two views on the left are of the front independent suspension, in front elevation and in section, respectively, while the view on the right shows the mounting of the steering gear.



The 1941 Nash

(*Continued from page* 306)

are finished in slow-baking, high-gloss Permalux enamel.

The independent front suspension of the Ambassador 600 bears some resemblance to that which has long been used on the Italian Lancia car. Vertical kingpins 20 in. long are supported at the top by a horizontal steel tube and at the bottom by a heavy bridge-type truss that forms part of the welded-steel body. A collar surrounding the lower part of this kingpin, and sliding up and down thereon on six roller bearings, carries the steering knuckle at its lower end. Its upper end supports a coil spring which in turn carries the body weight on a taper roller bearing. A direct-acting tubular shock absorber extends parallel with the kingpin between the steering knuckle and the tubular member supporting the kingpin. Rear suspension is on two long coil springs surrounding the direct-acting-type shock absorbers. Drive is through a torque tube which holds the axle in position relative to the frame in the fore-and-aft direction, while a transverse stabilizer bar with rubber cushions holds it in position laterally. Steering is by what is described as a new two-way ball-bearing system. The car has a turning radius of 33 ft.

Nash bodies for 1941 follow the torpedo trend and are available in either "slip-stream" or trunk-back styles. Changes have been made in the front-end styling of all Nash bodies. A horizontal radiator grille extends completely across the car. It contains sturdy, closely set chromed bars which curve slightly around the front of the fenders. Vertical die-cast, chromed grilles face off the smooth curve of the catwalk. Sealed-beam headlamps are fitted into the front of the fenders. Body interiors are finished in two-tone combinations.

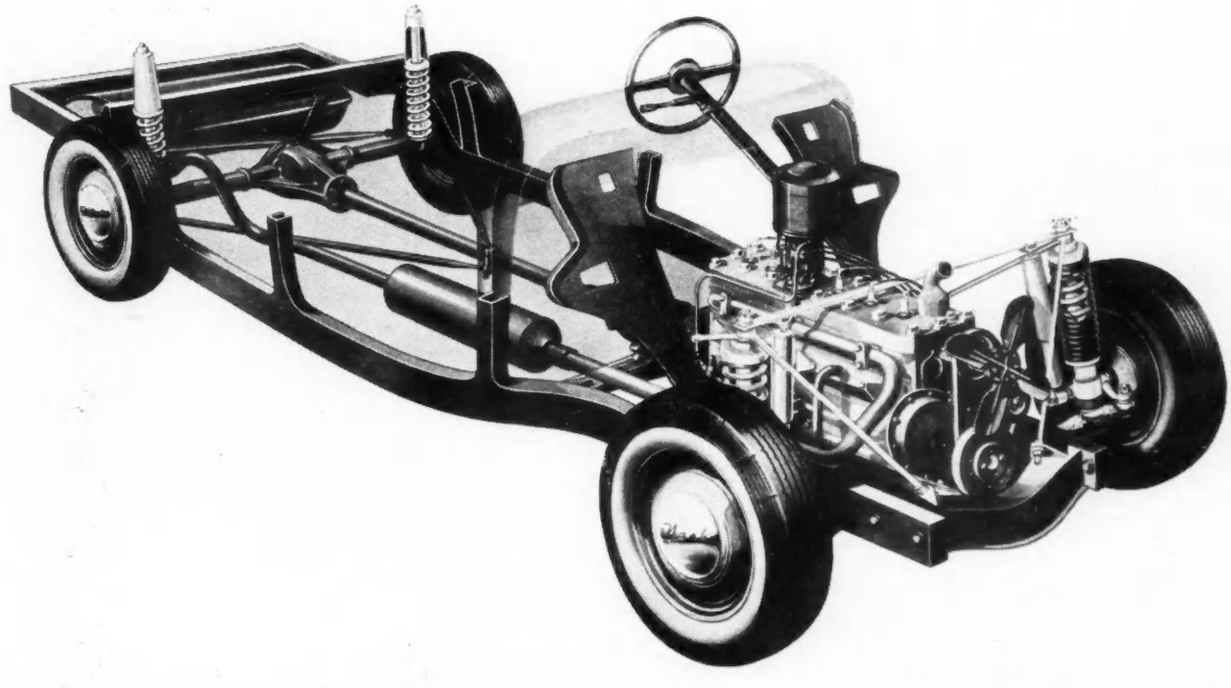
Engines for the Nash senior lines remain substantially unchanged. A touch of color has been added by painting the valve covers a silver gray and using red ignition cables. Both the Ambassador six engine of 105 hp. and the Ambassador eight engine of 115 hp. have double automatic spark control, steel-strut aluminum pistons, full-length water jackets, full-pressure lubrication with rifle-drilled connecting rods, and an "Iso-Thermal" fuel system.

The Nash senior Ambassadors also have front independent suspension on coil springs, but of a different design from that of the Ambassador 600, the parallel-link system being used. Direct-acting shock absorbers are located inside the coil springs. The upper control arms are insulated for silent action. Semi-elliptic leaf springs are carried at the rear, and are controlled by direct-acting shock absorbers. These springs are prelubricated and provided with metal covers.

Nash Ambassador senior lines for 1941 also have the unit frame and body construction. Improvements have been made in the "conditioned-air" equipment. These include a 70 per cent increase in capacity, a larger fresh-air intake, larger hopper, bigger heating core and air filter, a new outlet and twin fans. The new outlet, which is long and narrow, fits up snugly against the vertical toe-board and blows a current of air over the floorboards. The bed-in-a-car feature is continued and is available on sedan and brougham.

Sealed-beam headlights of the all-glass, hermetically

(*Turn to page* 427, *please*)



This view shows the Nash chassis frame which is built integral with the body; also the engine and body suspension

MEN AND MACHINES

(*Continued from page* 297)

the lower stem, thereby affording greater protection for the lower bearing from dust or moisture. Shock is absorbed by two opposing coil-springs connected to a rack-sleeve that slides on the spindle. The spindle operates independently of the rack-sleeve, so that any shock against the contact point is not transferred to the indicator's measuring mechanism.

The gear mechanism of the instrument, therefore, is safeguarded from shocks against the contact point when measuring. Furthermore, excess weight of gears is eliminated, resulting in less inertia and friction of the movement. There is said to be increased sensitivity, due to lesser surface contact between moving parts, and an even gear action regardless of the rate of speed in checking.

A "Standard" line of dial bore gages also has been developed on a modernized adaptation of the "two-point measurement" principle by which two independently operating plungers (radially located, one on either side of the measuring plunger) automatically and accurately centralize the gage in a bore. This insures diametric measurement through the center of the bore, with consequent true-precision accuracy and smoother action of the instrument.

The "Standard" dial bore gages are available in various types. Each has a wide range of adjustment. Only five sizes are required to cover diameters from 1 in. to 12⅛ in. Diameter extensions are furnished with each gage. Setting the gage to any desired size within its range takes but a few minutes. Measurements can be made within ¼ in. of the bottom of blind bores, making the gage applicable to holes with obstructions, such as shoulders, webs or undercuts. With the 0.0001 in. dial graduations, variations as close as 0.000025 in. can be determined readily.

A MODIFIED form of the regular model 45 B-60 pitch diameter gage built by Federal Products Corp., Providence, R. I., is illustrated herewith. The instrument is designed for holding large diameter work and is being used extensively in aircraft engine manufacturing plants.

Both anvils of the gage are provided with John-Son rollers which make three-point contact on the thread. The upper anvil is free to float and locate itself in the thread while it shows the true pitch diameter on the indicator. The lower anvil is adjustable for diameters and is provided for fine adjustment. The back stop is adjustable vertically and also may be equipped with a horizontal adjustment.

RECENTLY the Toledo Scale Co., Toledo, Ohio, built a machine for the Ford Motor Co. to be used in testing automobile chassis springs. The machine is designed to deflect the springs various definite amounts, and to indicate the force required.

Each of the machines installed at the Ford plant is capable of testing 300 springs an hour, consequently very little time is allowed to get a spring into position and compress it. Inasmuch as some springs have to be compressed 8 in. or more, it is essential that the member pressing the spring moves down the required distance rapidly, stops so that the pressure can be read, and then returns quickly to its zero position. At the Ford plant the testing procedure follows this sequence: Assembled spring is placed on the testing machine in proper position; operator steps on a treadle, the spring is compressed and a tolerance reading taken; operator releases pressure on the treadle and pressure is taken off automatically; the spring is removed and the machine is ready to receive another.

THE Lees-Bradner Co., Cleveland, Ohio, offers a chucking type thread milling machine that generates threads

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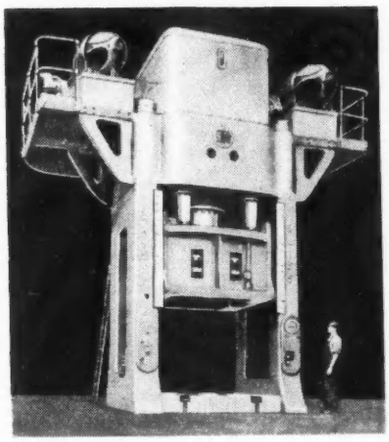
by means of the hob or ring type thread milling process. The machine is illustrated herewith. A cutter spindle driven by a two-step V-belt pulley, of sufficient size to furnish a flywheel effect, is mounted at the right-hand end of the machine. The nose of the cutter spindle is provided with a No. 10 Brown & Sharpe taper (or other suitable taper) and the spindle itself is drilled to permit the use of a draw rod to seat shank type ring or hob type thread milling cutters. The cutter spindle is driven by a separate motor. The work head mechanism is mounted on the left-hand side of the machine. It carries the hollow work spindle, which is mounted in hand scraped adjustable bronze bearings provided with take-up for wear. The spindle is driven by means of a worm and worm wheel through pick-off gearing from a V-belt drive sheave, actuated by a work head drive motor.

Work to be threaded is loaded into the work spindle and grasped by a suitable work holding fixture. The control lever is shifted into the feed position and a second lever, which brings the work into full depth position against a positive micrometer stop, adjustable for various diameters, is actuated. As the work spindle rotates in its bearings, it is fed axially in its bearings, by means of a thread on the rear of the work spindle, this thread engaging a nut rigidly fastened to the machine. When the work spindle has completed one and a fraction revolutions and has advanced along its axis slightly over one pitch, thereby generating the thread on the part, the work spindle actuates a micro limit switch which stops both motors.

By means of the second lever referred to in the preceding paragraph, the work is then backed out of engagement with the cutter and the first lever is shifted from the feed to the rapid traverse position; thus shifting this lever disengages the mechanical feed clutch and engages a rapid traverse friction clutch. Work spindle is rapidly traversed to its starting position, at which point the work spindle actuates a second micro switch, which automatically stops the rapid traverse. The threaded part is removed and a second part is then loaded into the work spindle, the feed is again engaged and the work is again brought into full depth position.

For various work spindle speeds required for different jobs, pick off gearing is available. To accommodate various jobs which can be handled on this machine, the work head assembly can be traversed toward or away from nose of cutter spindle by hand, and when properly positioned, is clamped rigidly in proper position.



Bliss 800-200-ton press with universal electric control and auxiliary hydraulic pressure cushion in the bed.

THE E. W. Bliss Co.'s 800-200 ton hydro-dynamic press illustrated herewith is of the double action type with universal electric control and an auxiliary hydraulic pressure cushion in the bed.

The pushbutton control employed on this press is such that the inner main slide cannot contact the work until after the desired blankholder pressure is applied by the outer slide. The main drive brings the two slides simultaneously to the work, the inner slide halting for a fraction of a second while

MUST the parts or materials you manufacture meet definite surface roughness specifications? Can you check your "finishes" quickly and with absolute assurance that your measurements will conform to the accepted rating standards? With the Profilometer in your shop, direct dial readings in true inch units give you roughness ratings exactly as they are shown on blueprints. No computations or scaling methods are required. It is the practical instrument for shop control of production.

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. . . almost every important manufacturer of engines specifies surface roughness ***and uses the Profilometer.*** Illustrated is the Profilometer in use in the plant of a large eastern aircraft manufacturer for the measurement of the finish on Nitralloy cylinder barrels after honing.

If you are now supplying—or plan to furnish—precision-finished parts to the aircraft industry, you, too, will find the Profilometer an important and necessary piece of equipment.

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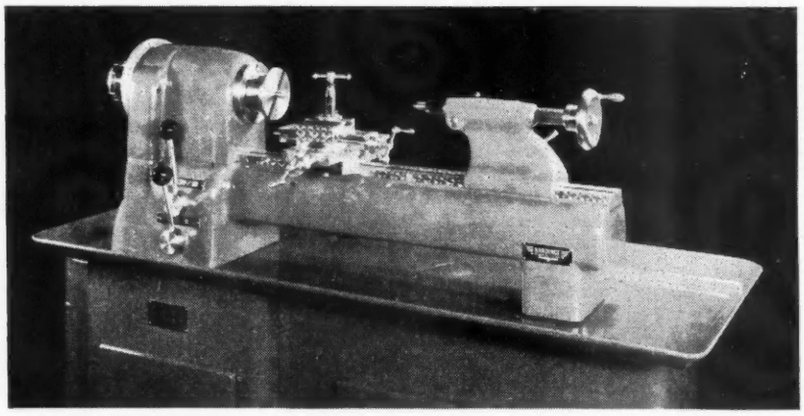

Hardinge's new lathe which is available in five sizes up to one-inch collet capacity and 19-in. swing.

the blankholder pressure is applied and then proceeding at the draw speed. Reversal may be controlled either by slide position or by pressure in the system. Positive inching for die setting is by means of pushbutton with the quick advance speed eliminated, permitting increments of approach of 1/16 in. or less.

The equipment is self-contained throughout and is complete with air filter, oil filter, oil strainers, circulating oil cooler and indicating oil temperature gage. Specifications of this press are as follows: capacity of the main slide, 800 tons; capacity of the blankholder, slide, 200 tons; capacity of cushion in bed, 150 tons; bed area front to back and right to left, 84 in. by 85 in.; distance top of bed to face of blankholder slide with slide up, 95 in.; with slide down, 69 in.; maximum stroke of main slide, 42 in.; overall height, 340 in.

ANNOUNCEMENT has been made by Hardinge Brothers, Inc., Elmira, N. Y., of a new high-speed precision lathe which the company describes as "a complete refinement of all similar, previous machines and, consequently, a proven machine that will fit into the present production program, from batteries in tool rooms and production departments to one or more machines in experimental and laboratory departments." The lathe is offered in five sizes up to one-inch collet capacity and nine-inch swing. There are eight forward and eight reverse speeds ranging from 230 to 3900 r.p.m.

GROB BROTHERS, Grafton, Wis., has developed a new heavy-duty continuous motion filing machine. This machine has a throat of 18 in., but the same model with 30 in., 36 in. or larger throat also is manufactured. Three file speeds, 80, 120 and 160 f.p.m., are provided. The files are attached to a chain which is driven by a lower pulley having spring-cushioned pins providing a positive drive. The machine has a low total height and the file-chains are relatively short in length.

ANNOUNCEMENTS of other new products received by this department in the past month are, briefly, as follows:

Binks Mfg. Co., Chicago—No. 460 series combination agitator and circulating pump units for use in spray finishing work. The unit is adaptable to all Binks TU type tanks. It is said to be especially suited for multiple spray gun operation and for short pipe runs. Air or electric motors furnish the driving power.

Black & Decker Mfg. Co., Towson,

quality BUILT IN!

"BARBER-COLMAN" Type "V" Hobbing Machine . . . Bijur Lubricated.

The correct oil film to each individual bearing... automatically

● Machine accuracy is maintained at maximum by Bijur lubrication. This centralized forced-feed system promotes better-quality work . . . higher speeds . . . bigger production at lower cost . . . longer-lived machines. Each bearing is fed *automatically*—the exact, metered oil-film demanded by its size, speed, load. Bijur lubrication is engineered to modern machine standards!

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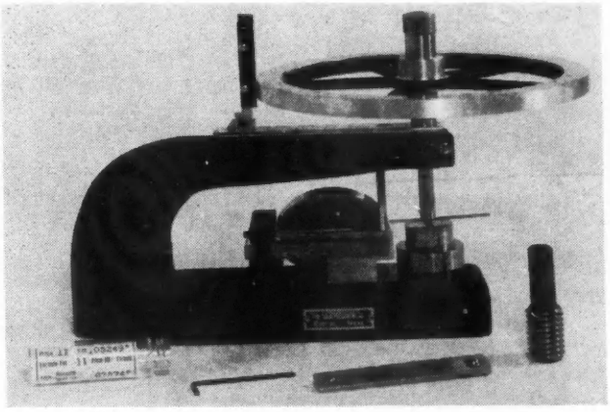


Light wave micrometer built by the Van Keuren Co., Boston, Mass. It is said to be ideal for making three wire measurements of pitch diameter and for measuring gages and precision parts.

Cincinnati Milling Machine and Cincinnati Grinders, Inc., Cincinnati, Ohio, has released two new catalogs, M-894 and M-886, both dealing with the company's improved line of **vertical "Hydro-Broach" machines.** M-894 is concerned with Duplex machines; the other gives data on single-ram equipment.*

E. F. Houghton & Co., Philadelphia, Pa., is distributing a leaflet entitled "Less Oil . . . Less Often," which discusses **lubrication of electric motors.***

A new twin horizontal **broaching machine** built by the Oilgear Co., Milwaukee, Wis., is described in Bulletin No. 21,000. Dual pushbutton control, alternative toe-lever control, variable broach-

Md.—Tapgun weighing 3¾ lb. and measuring 9¼ in. overall. It taps up to 5/16 in. in cast iron, 3/16 in. in steel, ⅜ in. in brass or aluminum. The Tapgun taps at 400 r.p.m. and backs out at 525 r.p.m.

Photoswitch, Inc., Cambridge, Mass.—Short interval timer, accurate over ranges from one-twentieth of a second to two minutes. Control is accomplished through a snap-action relay of 1000 watts capacity. Known as type T 15, the timer permits both momentary pushbutton and sustaining contacts control.

General Electric Co., Schenectady, N. Y.—New line of 500-amp. ac. arc welders with an electrical design which incorporates power-factor correction. When operated below half load, the welder provides leading reactive kva. for improvement of the shop power-factor; and when operated at no load there is 19.5 kva. available for this purpose. The machine is four feet in height, 21 in. in diameter, and net weight is listed as 600 lb.

Skilsaw, Inc., Chicago—A ½-in. drill, model 80, with no-load speed of 450 r.p.m. and full-load speed of 300 r.p.m. Drilling capacity in steel is ½ in. and in hardwood 1¼ in. It weighs 8 lb. and measures 11½ in. in overall length and 9¼ in. high.

Publications Available on Machine Tools

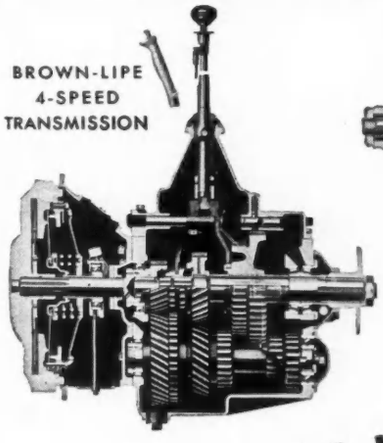
Index Machinery Corp., Cincinnati, Ohio, has prepared a pamphlet covering its Lester-designed fully automatic **injection molding machines.***

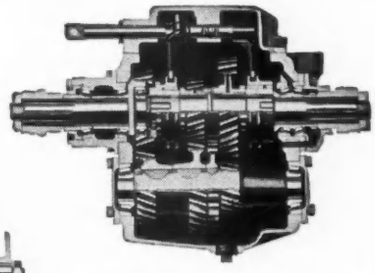
"Honed Microfinish for Aircraft Parts" is the title of a brochure offered by the Micromatic Hone Corp., Detroit.*

The Carlyle Johnson Machine Co., Manchester, Conn., has issued a new catalog containing data covering its line of Johnson **friction clutches.***

A **lock nut** with a built-in locking element in the form of a threaded spring steel retainer made slightly oval is described in a leaflet published by the manufacturer, Security Metal Products, Inc., Kalamazoo, Mich.*

A new bulletin published by Hardinge Brothers, Inc., Elmira, N. Y., is devoted to this company's new high-speed precision **lathe.***





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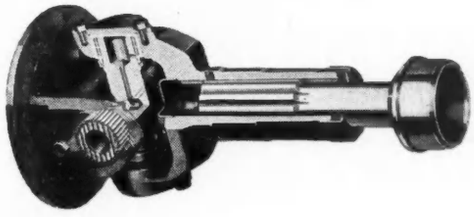

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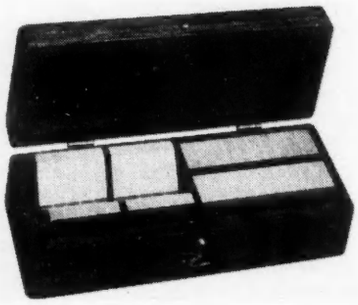


George Scherr Co.'s set of magnetic parallels and V-blocks for use with magnetic chucks.

ing speed, simple oil and electric circuits, hardened and ground ways, motor driven coolant pump and other features of the machine are described.*

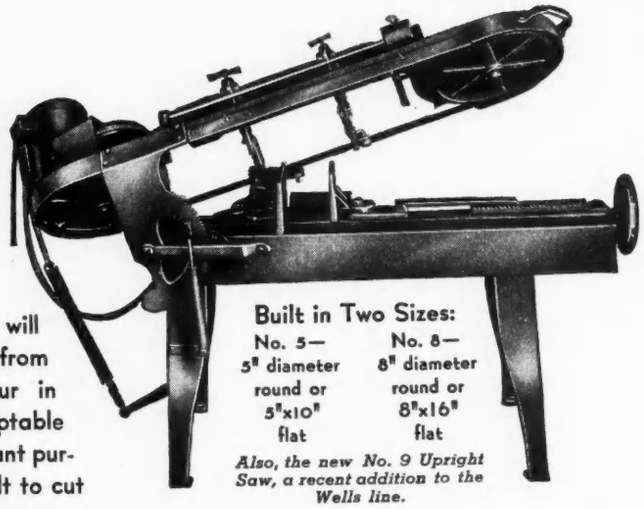
"Dritherm" **infra-red ray carbon lamps** and the use of **radiant energy** to solve industrial drying problems are discussed in a booklet prepared by the North American Electric Lamp Co., St. Louis, Mo.*

The line of **industrial lubricating equipment** made by Lincoln Engineering Co., St. Louis, Mo., is the subject of this company's newest catalog, No. 61.*

A very attractive brochure entitled **"Hydraulic Precision Presses"** has been prepared by the Clearing Machine Corp., Chicago. Applications, operating advantages, design and construction, capacities and size of a few of the many types of presses built by Clearing are covered in the new publication.*

*Obtainable through editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

Cut time waste with a WELLS SAW



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Also, the new No. 9 Upright Saw, a recent addition to the Wells line.

WELLS SAWS will cut minutes from every sawing hour in your plant. Adaptable to almost every plant purpose, they are built to cut metals faster, more accurately, and at lower cost. Ruggedly constructed with years of sawbuilding experience behind each machine, Wells Saws will save you time and money. Sold through leading Mill Supply dealers—or write directly to us.

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THREE RIVERS • MICHIGAN

WELLS METAL CUTTING BAND SAWS

1941 Ford Lines

(*Continued from page* 312)

eters of approximately 1⅞ in and ⅞ in. The end with the smaller diameter fits into a recess in the body-support stamping. The other part is a rubber ring 1⅞ in. in diameter with a 1-inch hole. This is placed on the other side of the body support stamping, and the body bolt, with a large cupped metal washer under its head, clamps the two pieces of rubber together. A metal sleeve or bushing on the bolt prevents the rubber insulators from being compressed beyond a predetermined amount when the body bolts are tightened.

Front-fender construction on both the Ford and the Mercury is unique and interesting from both the manufacturing standpoint and the service angle. Instead of being a one-piece formed or welded stamping, the fender is of the multiple-section type, a number of separate simple stampings being fastened together to form a built-up unit. In case of damage, individual sections can be removed and replaced.

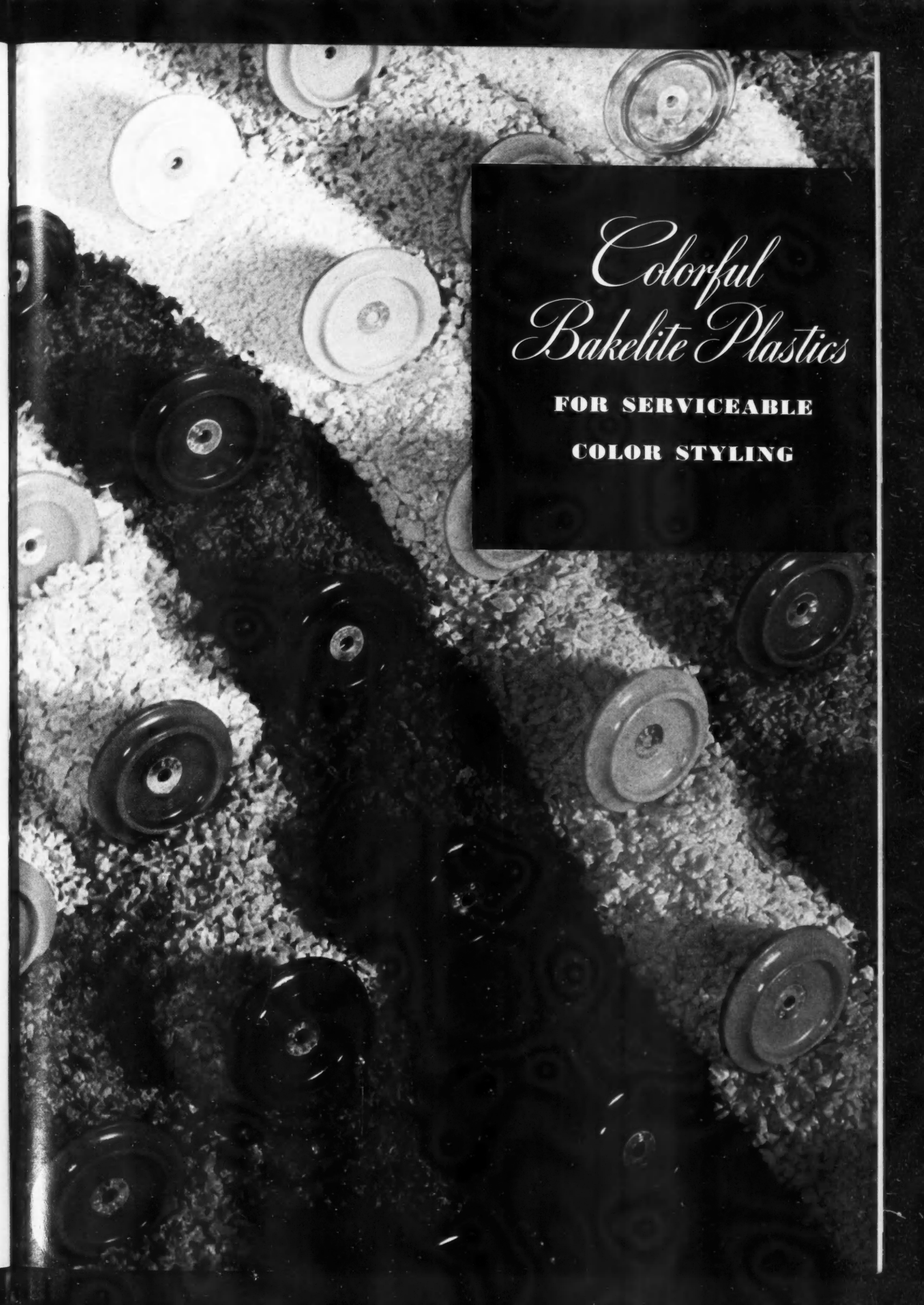
In the convertible club coupe, where body sound-deadening is not a problem and where increased rigidity should be provided for the body sides, since there is no solid top construction to reinforce them, metal spacers take the place of the rubber insulators.

Hoof Announces A New Governor

Hoof Products Co., Chicago, recently announced a refinement of its calibrated governor. The governor has been made more compact, about half its former size. Its shape conforms with the general contour of the carburetor, thereby avoiding interference with rods and controls. A vacuum-controlled automatic spark advance transfer is an integral part of the governor body and provides a positive means of spark advance transfer without requiring separate parts or attachments.

Motorcycle Production Up Appreciably In '39

Reflecting an increase of 19.4 per cent, the value of motorcycles, bicycles and parts produced in 1939 was $43,052,278 compared with $36,044,287 reported for 1937, according to the Bureau of the Census. Employment made a slight gain, rising to 6973 from 6938, while wages increased 9.3 per cent to $8,973,875 from $8,206,866.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FOR SERVICEABLE
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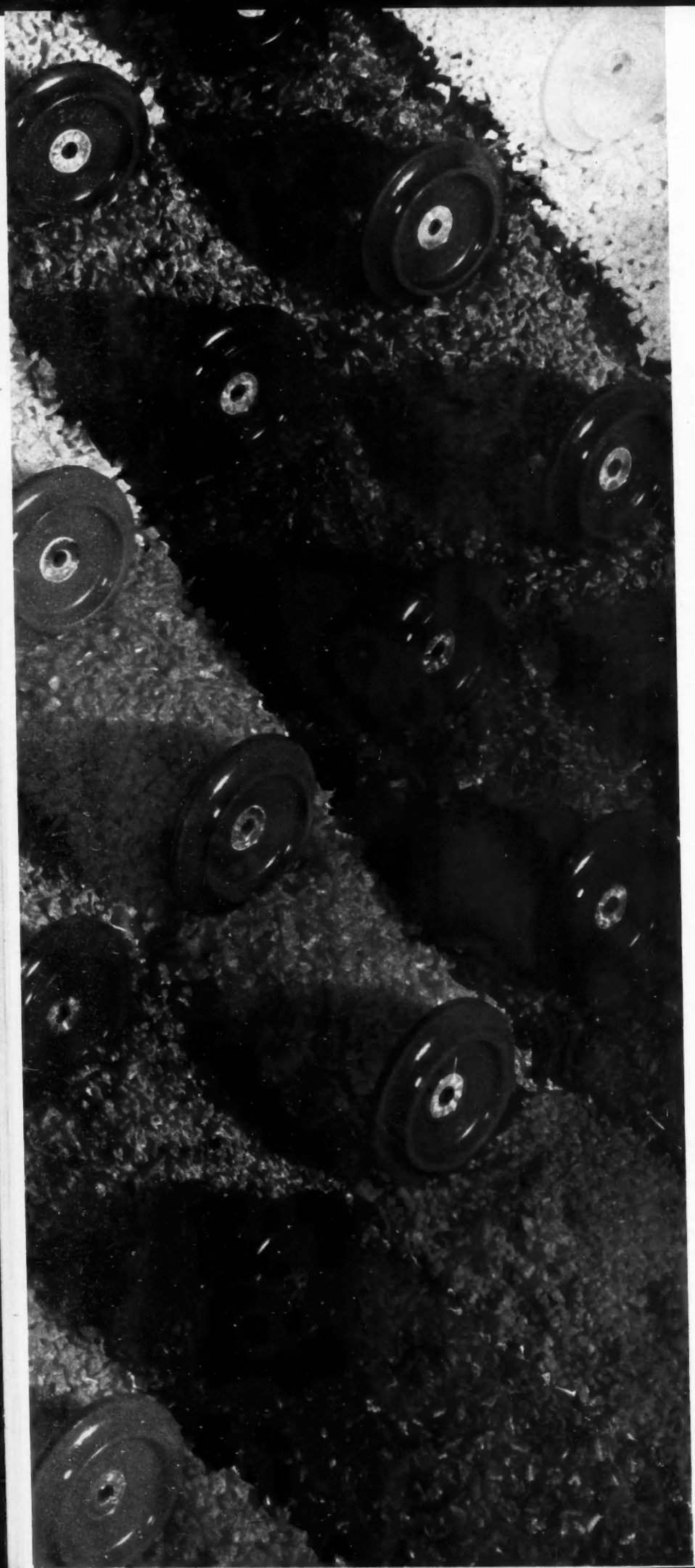

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WHEN Bakelite Plastics are employed for color-styling automotive parts and equipment you have at your disposal not only a complete range of colorful opaque, translucent and transparent effects, but also many *types* of materials such as Cellulose-Acetates, Polystyrenes, Phenolics and Ureas. Contributing valuable service characteristics, as well as sales-stimulating color, these versatile plastics meet virtually every requirement of design and utility.

For instance, Bakelite Cellulose-Acetates are tough, resilient and unusually resistant to mechanical shock and vibration. In addition, they are noted for their exceptionally high luster. A special type provides, also, increased resistance to heat and water.

Bakelite Polystyrenes offer not only outstanding resistance to moisture and chemicals, but also provide dimensional accuracy. Their electrical insulating characteristics are unsurpassed by any other organic plastic.

Bakelite Phenolics offer many diversified properties where rich, dark, opaque colors are required. Depending upon specific requirements, they provide varying degrees of resistance to heat, water, chemicals, oils, impact and cold flow.

Bakelite Ureas, available in white, ivory and pearl, are distinguished by unusual hardness, as well as excellent color-stability.

For colorful plastics that will give *serviceable* color-styling to your automotive designs, consult Bakelite Plastics Headquarters. Further information may be obtained by writing for booklet 4P, "New Paths to Profits". Ask also for the "Plastics Comparator" which shows tables of relative values for various types of molding materials.

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PLASTICS HEADQUARTERS

GUIBERSON AIRCRAFT-TYPE DIESEL ENGINE

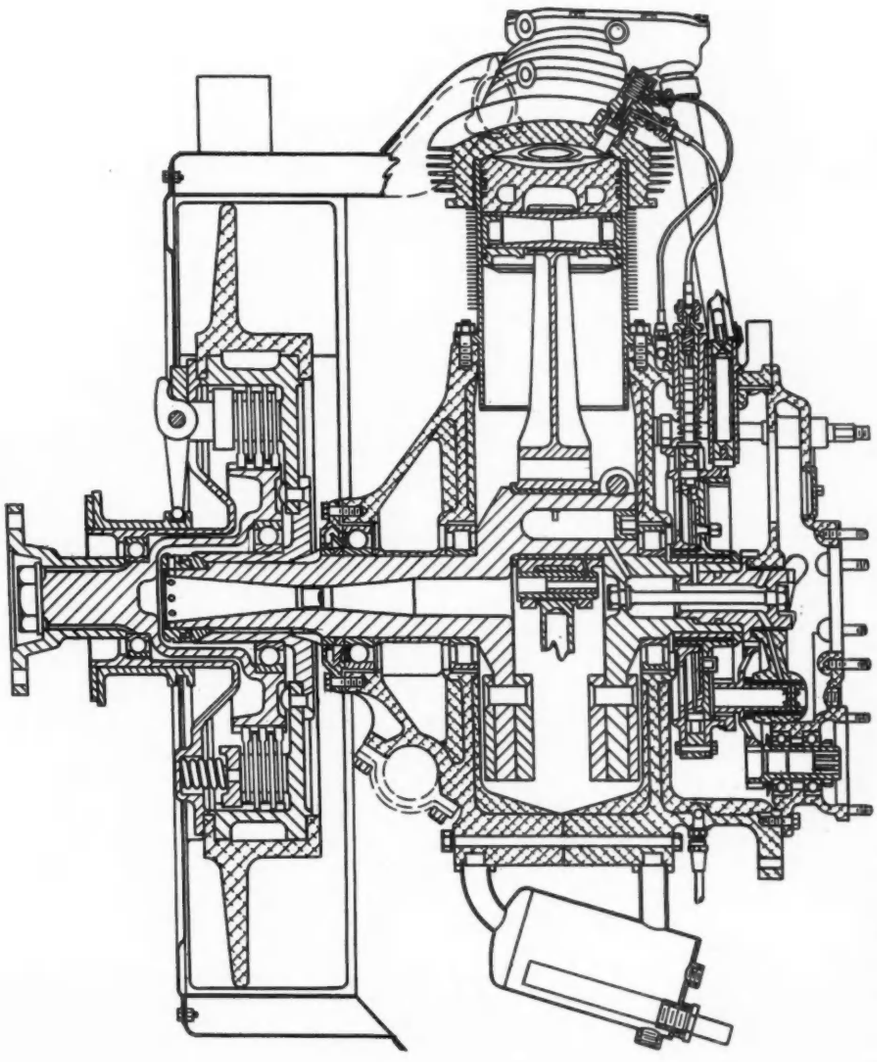
Sectional Views

Herewith are shown front and rear elevations and sectional views of the Buda Guiberson Diesel engine. The Buda Company is now in production on engines of this design for light-weight Army tanks and other ground equipment, and we understand that 90 per cent of the parts of this engine are interchangeable with the Guiberson aircraft engine.

This nine-cylinder radial, air-cooled engine has a bore of 5⅛ in. and a stroke of 5½ in., which makes its displacement 1021 cu. in. Solid injection is employed and the compression ratio is 15:1. The rated output is 250 hp. at 2200 r.p.m. but the engine is claimed to develop a maximum of 265 hp. at 2250 r.p.m. The specific fuel consumption is given as 0.395 lb. per hp.-hr. at 85 per cent rated speed and full power and as 0.415 lb. per hp.-hr. at rated speed, rated power and also at 60 per cent rated speed and full power.

The crankcase is made of aluminum alloy in two sections. The crankshaft is in two parts made of SAE No. 2512, a 5 per cent nickel, case - hardening steel. The crankpin bearing has a diameter of 2.375 in. and a length of 3.25 in. All main bearings are of anti-friction type (ball and roller), as shown in the sectional view. There is a counterbalance on each crank arm. The two parts of the crankshaft are forged with integral balance weights, but additional counterbalances are secured to these by riveting. The master connecting rod, which is forged of No. 6145 steel, has a center-to-center length of 11.25 in., while the eight link rods, made of the same material, have a center-to-center length of 9 in.

Pistons are of aluminum alloy and carry three compression and two oil rings each, one of the oil rings being a scraper ring and the other a slotted ring. Wrist pins float in both the piston and the rod, and



GUIBERSON AIRCRAFT-TYPE DIESEL ENGINE

Installation Views

are held from drifting by aluminum alloy plugs.

The cylinder barrels are made of No. 4130 steel and the cylinder heads of aluminum alloy, the heads being screwed to the barrels with a shrink fit. Aluminum bronze valve-seat inserts are shrunk into the heads. Both the intake and the exhaust valves are of Silcrome. Dual valve springs of chrome-vanadium spring steel are fitted. Valves have a diameter of 2 5/16 in. and a lift of ½ in., and the spring pressure with the valve closed is 85 lb. Valves are operated through enclosed pushrods and rocker levers from a cam ring with a base diameter of 9 3/16 in.

Fuel injection is by the Guiberson system, the injection valves being secured to the cylinder head and injecting directly into an undivided combustion chamber. Injection pumps, arranged radially at the front of the engine within the cam-gear housing, are operated through the same gearing as the cam ring.

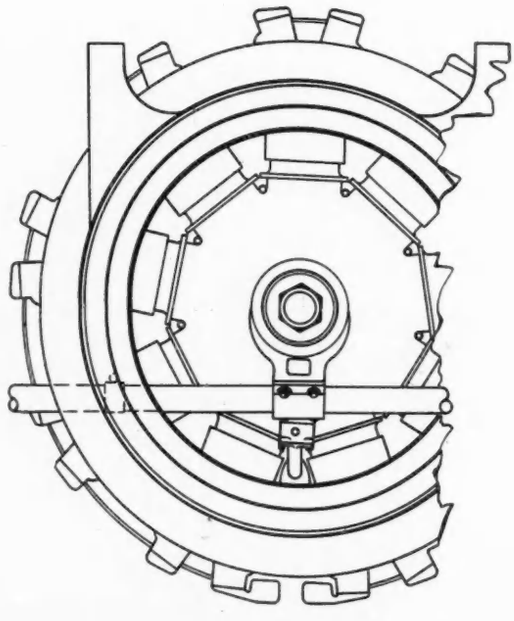
Lubrication is by the pressure system and the oil pump has three sections, viz., a pressure section, an engine-scavenger section and a rocker-box-scavenger section. Oil in the lubrication system is kept under a pressure of 85 lb. per sq. in.

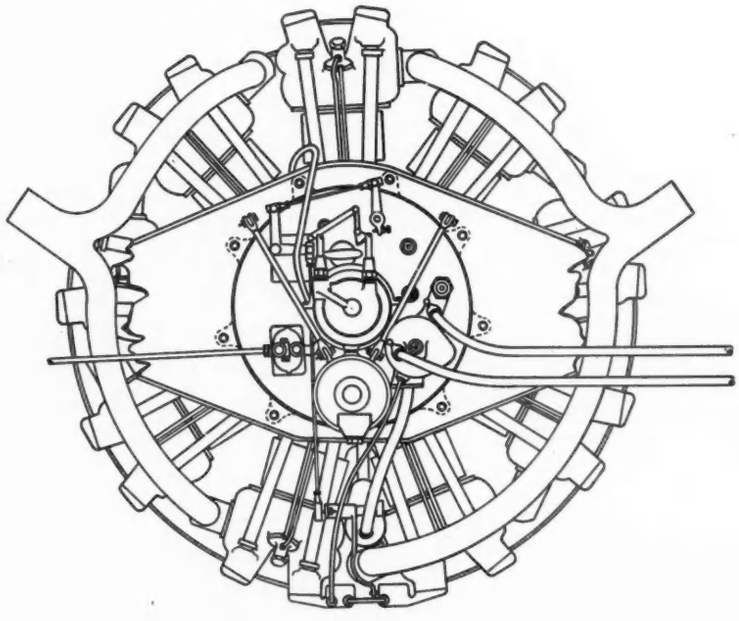
The dry weight of the aircraft engine is 616 lb., while the weight of the complete aircraft installation, with cowling, shrouding, inter-cylinder deflectors and intake and exhaust manifolds is 725 lb.

In the sectional view the engine is shown equipped with a large cooling fan as used in tank installations.

The manufacturer's test specifications call for running each engine with injectors removed, five hours or more on a run-in stand before operating it under its own power. Each engine is operated for two hours below 1600 r.p.m. It is then adjusted and balanced for temperature readings at 1800 r.p.m. After a power-run of three hours with 75 per cent or more of the rated horsepower being developed at 2000 r.p.m., the engine is disassembled and inspected. Following reassembly there is an additional check run at 2000 r.p.m. for temperature readings. A full-load run of one hour, with the engine developing rated power at 2200 r.p.m., completes the test. Providing temperatures, oil consumption and fuel consumption are within required limits, the engine is removed from the stand and prepared for shipment.

The engine is equipped with a Coffman starter drive gear to which may be attached any of the Coffman type cartridge starters. One tachometer drive is provided to the rear of the oil pump assembly. A generator drive in the gear train is located below the starter flange. It is a standard SAE aeronautic generator mounting for a Eclipse E-5, model 2617-B-1, with a capacity of 50 amp. and voltage regulated to a constant value of 15. A C-5 aircraft fuel supply pump is attached to the standard SAE pump mounting. Fuel pressure delivered from the C-5 fuel pump is regulated to a minimum of 4 lb. per sq. in.; maximum 8 lb. per sq. in. in the fuel duct.





AVIATION

(*Continued from page* 342)

low volatile fuel in the interest of safety, would improve starting and acceleration because it could be depended upon to give better distribution of fuel in the cylinders. A number of companies have been working with Government bureaus in this work, and there is every indication of some important announcements of successful achievement before many months.

Many aeronautical engineers see in molded plastics an answer to some of the problems of aircraft building. Thousands of parts a day are being produced by scores of the 235 manufacturers in this country for aircraft radio and instrument parts. Molded plastics are being used for electrical conduits; the plastic part is plated with metal to serve as a radio shield. A wide range of physical properties are available from the plastic industry—and almost all the raw materials are available in the United States.

Plastic impregnated laminated wood is being molded for wings and other structural parts. Here we find, as in so many new developments, a controversy between the practical manufacturer and the research scientist. The latter feels that more research is needed; the former, whose business it is to get things done now, feel that the art is ready for production of large sections. "It would require large machines, but it can be done," stoutly says Roy E. Berg, vice-president and general manager of Tech-Art Plastics Co.

Thus we see today the aircraft industry availing itself of the reserve engineering and manufacturing experiences of the whole of this great industrial nation. Every manufacturer in the aircraft, engine, accessory, and instrument fields is as shocked to hear and read what is going on overseas as anyone else in this country. Many are far better informed about actual conditions than most of us. All are keeping in as close touch as possible with each succeeding development abroad with view of giving us the maximum protection in the air.

Scores of the largest companies in the industry have gone ahead with huge expansions instead of waiting for Congressional pow-wows to crystallize into tax laws, amortization schemes, factory confiscation, and other pivotal laws. None has time these critical days to peruse the *Congressional Record*, or to worry much about what the legislators are saying, although they have willingly devoted the time and energy to go to Washington when called upon to testify before Congressional committees.

In spite of the many and real hazards involving manufacturers in this national defense program, there seems no reasonable doubt on the part of those working on the job of arming the American Army and Navy that the principal objectives of this huge program are going to be achieved—and on schedule.

P&W Contract for 17,000 Engines in 1941 and 1942

Frederick B. Rentschler, chairman, and Eugene E. Wilson, president of United Aircraft Corp. have confirmed the conclusion of negotiations for the purchase of Army and Navy requirements of Pratt & Whitney engines for the fiscal years 1941 and 1942 amounting to approximately 17,000 engines of various types ranging from 500 to 2000 hp.

Percy Pierce

Percy Pierce, 62, son of the late George N. Pierce, founder of the Pierce-Arrow Motor Corp., and internationally-known automobile driver, died in Buffalo on Aug. 28. He won the first two of the famous Glidden endurance tours, in 1906 and 1907.

APPROVED
. . . by those who buy
YOUR TRUCKS

Above all things the truck operator must have accuracy and reliability in the governor he uses. His schedules must be maintained without interruption . . . or he suffers a loss.

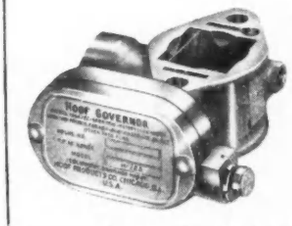
More and more operators insist on Hoof Special Calibrated Governors . . . standardizing on this governor because of year in and year out dependable service, even under the most difficult conditions.

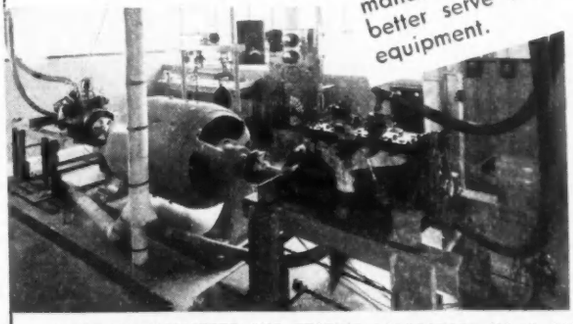
Always outstanding, Hoof Governor performance and durability are greatly enhanced in the new "streamlined", simplified, compact model . . . with in-built positive spark control transfer. Smaller in size it is more adaptable than ever to the modern engine.

Whatever requirements are demanded, the Hoof Governor will better serve those who buy your equipment.

Star attractions

★ FACTORY SET . . . No road testing necessary.
★ STAINLESS STEEL PARTS . . . No corrosion or sticking.
★ CANTILEVER SPRING No stretch or fatigue.
★ ALUMINUM BOD No warping or distortion.
★ DIAPHRAGM CONTROL No "cheating."
★ 3 BALL BEARIN No friction.
★ POSITIVE SPARK CONTROL
★ NO ACCELERA LOSS
★ FULL POWER





Every Hoof Governor is engine tested and calibrated on the Dynamometer . . . pre-set to the R.P.M. your specifications call for.

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HOOF PRODUCTS CO., . . . 6543 S. Laramie Ave., CHICAGO, ILL.
Makers of the FAMOUS HOOF CANTILEVER GOVERNORS.

1941 Chrysler

(*Continued from page* 314)

passenger four-door sedan, eight-passenger four-door sedan, eight-passenger sedan-limousine and four-door town sedan. The town sedan in the Custom Imperial line is built on the shorter chassis of the New Yorker, but carries as standard equipment all the quality features of this luxury line, including the All-Weather air-control system.

Improvements which have been made in the Chrysler line this year affect appearance, roominess, performance, comfort, safety and car life. Fluid drive, which has been available on the higher-priced Chryslers for the past two years, is now standard equipment on all eights and available at extra cost on the sixes. All models are longer, some of them as much as 7½ in.

The "Airflow" body has been redesigned to improve its appearance and add to its passenger space, and the hood and fenders also are new. Bodies are longer and wider, while the overall height has been reduced 1½ in. All seats now accommodate three adults comfortably. Seats are even wider than in the original Airflow, the seat cushions being 52 in. wide by standard measurements, and there is more leg room in both compartments, and more head room.

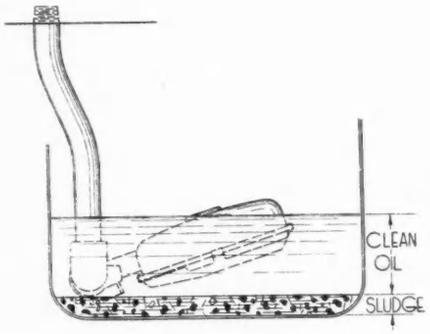
Engine horse power has been stepped up by refinements in design and the use of a new multiple-jet-type carburetor. In each carburetor unit, one jet is used for idling, another for normal driving, while a third comes into action automatically when the driver fully depresses the accelerator pedal. A new type of crankshaft bearing with thin babbitt lining is said to greatly increase bearing life. Another new feature is the "Vacamatic" transmission used in connection with the fluid drive.

Mechanical improvements in the 1941 Chrysler include oil-bath-type air cleaners as standard equipment, floating-type oil screens on the pump inlet, a Gerotor oil pump, thermostat and water elbow redesigned for quicker warm-up and better heater performance, improved seals and gaskets, trunnion-type shift mechanism on eight-cylinder cars which prevents "locking in gear" and reduces the effort required for the shift-over, reduced pedal travel and relocation of the over-center spring to reduce friction and minimize pedal effort, improved clutch-housing ventilation through screens and louvers, improvements in the gear-shifting mechanism to make shifting easier and smoother and reduce noise and wear, grooved-section leaves in rear springs, addition of a rear sway bar, elimination of the offset in the brake pedal by moving the pedal 2½ in. from the car center, introduction of a new master brake cylinder combined with the pedal bracket, to obtain a more rigid construction and improve brake action, and the adoption of the new safety rim which reduces the hazards of blow-outs.

The new frame is of the double-channel type, two U-shaped sections being welded together to form the side rail. There is no X-member in this frame.

The radiator grille comprises six chrome-plated horizontal bars extending to the headlamps. The hood is longer and the bumper is protected by three ornamental bumper guards. There is a more rakish slope to the windshield, the area of which has been increased to 676 sq. in. This, combined with narrower corner posts, increases the vision. Rear windows also have been increased in size, to 524 sq. in. Luggage compartments now have a hinge with counterbalances, which eliminates the need for a lid prop. The hood lock is now located inside the driver's compartment.

A large variety of upholstery and trim combinations are available. More extensive use is made of plastics in interiors, and two-tone colorings in the instrument-panel plastics are available to match various upholstery and trim combinations. The speedometer and other instruments are grouped in a panel directly in front of the driver's seat, and reading of the instruments is facilitated by a new steering wheel in which there are no spokes in the upper half. A "direction signaller" is standard equipment on some models



FLOAT-O

The FLOAT-O Family Keeps Pace with the Automotive Industry

BECAUSE IT

Supplies bearings with the "Cream" of the Oil . . . from the top of the Crankcase

The sludge, filings and heavy abrasives which cause serious engine wear and inefficiency naturally precipitate to the bottom of the crankcase. FLOAT-O, installed at the pump intake, draws horizontally from the clean oil found at the top . . . it does not disturb the harmful substances found at the bottom of the crankcase. With FLOAT-O only this "cream" of the oil sump is distributed to the bearings. This is true during starting and all running conditions. FLOAT-O is also a definite guarantee against ice-locking. Indorsed and approved by the leading research engineers of the industry, FLOAT-O insures quicker starting, smoother operation and longer life for engines.

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The following outstanding manufacturers use FLOAT-O:

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TAYLOR SALES ENGINEERING CO.
ELKHART INDIANA

and optional on others. A lever mounted on the steering column operates flasher lights on the front fenders as well as tail lights, to indicate the direction of a turn.

All doors are now provided with door checks. Front-door hinges have been redesigned to increase the maximum door opening by 10 deg. Sponge-rubber seals are used on all doors.

Two new body styles are offered for 1941, a six-passenger club coupe available in all models except the Crown Imperial, and a town sedan that may be had throughout the line. The club coupe has a full-length rear seat, which has been raised to afford greater visibility, and its legroom has been increased by 4 in. The door in this coupe is 48 in. wide—5 in. wider than in former models, and there is a larger window which raises and lowers. The town sedan has front doors 40½ in. wide and rear doors 37 in. wide. Rear doors are hinged to the center pillar. There is no quarter window in the rear compartment, but both front and rear doors have ventilating wing windows.

Wright Will Build Magnesium Foundry

Plans for the construction and equipment by the Wright Aeronautical Corp. of the nation's first magnesium foundry for the manufacture of castings for aircraft engines, were disclosed recently by G. W. Vaughan, president of the Curtiss-Wright Corp.

1941 Packard

(*Continued from page* 299)

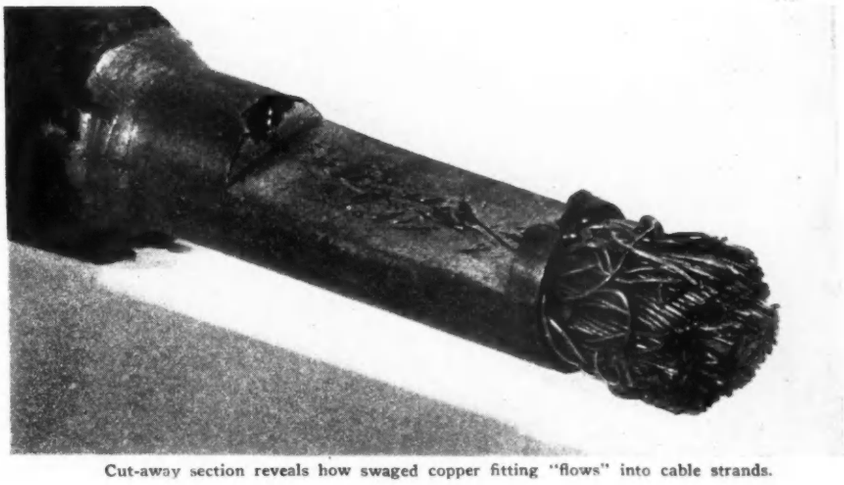
rubber-insulated, and needle bearings have been introduced in the steering knuckles. The steering gear roller now is mounted on a ball bearing. Opposed-piston-type front shock absorbers are found on the 110 and 120. At the rear, direct-acting shock absorbers have been adopted on the 160 and 180 chassis. The gooseneck tension shackle mounting at the rear is now employed also on the 160 and 180 models of the 1941 line.

The new overdrive (made by Warner Gear), developed last year, is again offered as optional equipment. It cuts in or out automatically at around 21 m.p.h., thus offering the advantages of the overdrive under practically all city driving conditions without need to resort to the manual cut-out.

Tires have been increased in size, to 15x6.50 on the 110 and to 15x7.60 on the 120. On the short-wheelbase 160 and 180 the tires are the same—16x7.00, four-ply. On the long-wheelbase 160 and 180 they are of the same dimensions but six-ply. On the long-wheelbase 180 tires with rayon twist cords are furnished as standard equipment.

The rear window in all bodies is a single piece of heat-treated curved glass. New decorative features include front and rear fenders of new design, separated running boards, heavier chrome belt molding, and massive front and rear bumpers.

The two-tone paint options and the many interior trim and upholstery options make it possible to produce striking combinations and contrasts to suit the whim of any discriminating car owner. All two-tone paint cars are fitted with a continuous belt molding extending completely around the back. This is standard on 160 and 180 cars.



Detail of engine mounted compressor for air-conditioning system in 1941 Packard

Cut-away section reveals how swaged copper fitting "flows" into cable strands.

For pointing, reducing, attaching fittings to wire cable, forming tubing, and fastening bushings on shafts—use "STANDARD" Rotary Swaging Machines.

Advantages include:

1. No loss of material—an important saving.
2. Improved physical characteristics of metal.
3. Any number of parts duplicated to close tolerances.

"Standard" Swaging Machines are available in sizes with capacities from 1/16" to 6" dia.; all shown in Catalog Section SM—ask for a copy.

IT'S STANDARD PRACTICE

MACHINERY COMPANY

PROVIDENCE, RHODE ISLAND

Outside door locks on both front doors are supplied on all models, except the 110. A gas-filler door is fitted on the rear fender on all models. Spare tire mounting is vertical on all sedans.

Interior trim treatment is new on all models, which have a handsome instrument panel and a new T-spoke steering wheel. The instrument panel features a generous use of plastics, with a large plastic center section for the radio grille, plastic side panels, and large plastic knobs on the panel and interior hardware. These plastic units are supplied in colors harmonizing with the interior trim options.

Fender-mounted six-wheel jobs are available at extra cost on all models except the 110. Airfoam seat cushions are available on the 110 and 120 as special equipment.

The hood, which is 2½ in. longer on all models, features two top panels hinged at the center molding and latches mounted on the hood sides. The front grille is a sheet-metal assembly quite similar to last year's, and, as before, has thermostically controlled shutters on the Senior models. From a service standpoint the interesting thing about the shutter construction is the location of the thermostat directly under the hood, where the entire mechanism is exposed and readily accessible.

1941 Oldsmobile

(*Continued from page* 303)

a large die-cast grille which extends the full width of the panel and broadens out at the center for radio installation.

Convertible coupe models are fitted with a vacuum-operated power mechanism for raising and lowering.

Body insulation against heat and cold and fumes has been greatly improved. The steel-top panel has a soft pad cemented to its underside to prevent drumming and transfer of heat or cold. The back, side and door panels have special mats stamped with waffle-shaped impressions, which form dead air spaces between the mats and metal, providing protection against heat and cold. Furthermore, special "Saftiseal" insulation is sprayed on to body panels to prevent entrance of dust and fumes. The dash and cowl also are insulated with thick mats of special material. The floor is covered with a thick insulating pad over which the floor mats are placed.

In addition, all doors and windows are sealed against wind and water leaks with a soft rubber windlacing. The stationary windshield and rear windows are permanently sealed in place with plastic cement between the body, rubber gaskets, and glass.

The cowl ventilator, too, is completely sealed by a one-piece rubber gasket fitted in a groove in the edge of the ventilator opening. When closed, the cover is pressed tightly against the gasket of the ventilator drain trough in the body cowl, thus preventing water or air from getting in.

Three types of heater "packages" are offered as optional equipment by Olds. The first of these, to be described more in detail later, is the Oldsmobile Condition-Air unit which provides automatic pressure heating with defrosting and filtered air ventilation. The second is the deluxe dual-flow dash heater and defroster. The third is the underseat heater, improved to effect better distribution of heat between front and rear compartments.

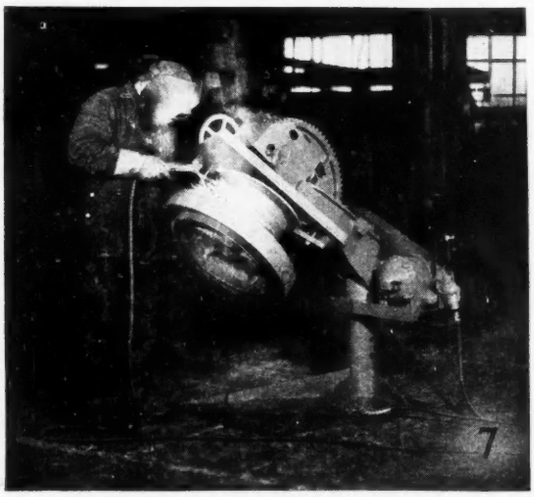
The new Condition-Air heating system is installed as a unit in the cowl ventilator, taking fresh air directly from the outside. Incoming air is filtered to remove dust and dirt, and water removed by passing through a rain trap. Filtered air then passes over the large hot-water radiator core and is forced into the passenger compartment under pressure. Auxiliary heater and defroster fans maintain heat flow and air circulation when the car is stopped or traveling at slow speeds.

The heater is automatic in operation due to thermostatic control of the volume of hot water flowing through the heater core. The desired temperature is selected by turning the control knob on the dash.

The same unit may be used also to provide greater comfort in summer, by supplying outside air under pressure.

WELDING AT ITS EASIEST

With a C-F Positioner, welding small or large jobs becomes easy, thoroughly convenient. The work is simply fastened to a table which turns in a full circle and may be tilted 135° from horizontal to position any weld . . . on top, bottom or sides . . . for "down-hand" welding. C-F Positioners make convenience pay—in safety from less handling—in crane service time—in saving welder's hours.



C-F Positioners are hand operated or motor driven and all movements are independently controlled. Table is adjustable in height or may be entirely removed for production fixtures.

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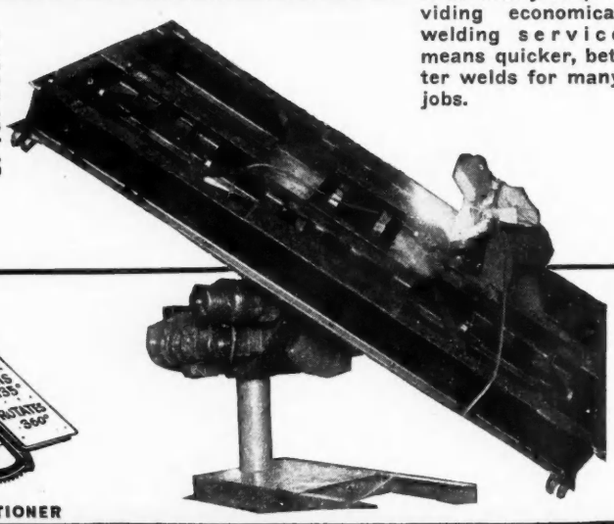
Write today for complete information about C-F Positioners. Their wide utility in providing economical welding service means quicker, better welds for many jobs.

Above illustration shows 2500 lb. capacity machine in use. The one at the right is a 6000 lb. machine. C-F Positioners are made in four sizes 1200, 2500, 6000 and 14000 lb. capacities.



CULLEN-FRIESTEDT CO.,
1316 S. KILBOURN AVE. · CHICAGO, ILLINOIS

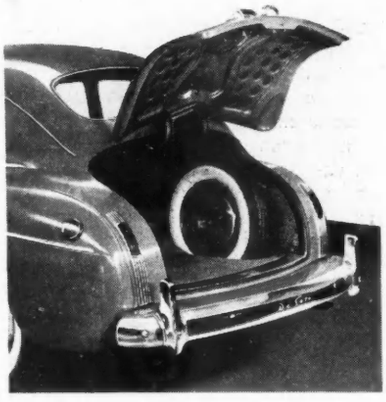
1941 DeSoto

(*Continued from page* 305)

by means of a single vacuum-controlled diaphragm which operates a shifter fork acting on a sliding clutch collar between the drive pinion and the third-speed gear.

As a further control, the timing of gear changes is effected by means of a centrifugal governor driven off the countershaft. The governor closes the circuit of a solenoid which, in turn, operates a latch in the diaphragm mechanism. The governor is so arranged as to permit a shift from third to high at about 15 mph., and an automatic return to third when the car speed drops below 13 mph. The shift actually occurs only when the driver lifts his foot off the pedal. In the same way the shift from first to second is made at about 8 mph.

As can be seen from the longitudinal section of the transmission herewith, the general arrangement of gears is very much the same as in a conventional three-speed transmission. All gears except the reverse are helical and remain in mesh constantly. The chief differences are that the driven member of the first reduction set, instead of being integral with the secondary gear cluster, drives it through a free-wheeling unit or over-running clutch and that the driven members of the low-



Generous storage space is provided with spare tire in vertical position.

speed and intermediate gear sets, instead of being rigid with the main drive shaft, are normally free but can be coupled thereto by means of a sliding collar which is under the control of the manual shift lever. There is a similar sliding clutch between the driving pinion and the driven gear of the intermediate-speed set, which is under the control of the vacuum-actuated diaphragm. DeSoto refers to this intermediate-speed driven member as the "third-speed gear." Reduction ratios and powerflow for the four speeds are as follows:

First speed (3.07), from drive pinion through free-wheel gear, to cluster gear, to low-speed gear to main shaft.

Second speed (1.98), from drive pinion to third-speed gear to cluster gear to low-speed gear to main shaft.

Third speed (1.55), from drive pinion to free-wheel gear, to cluster gear, to third-speed gear, to main shaft.

Fourth speed or direct drive (1.00), from drive pinion to third-speed gear, to main shaft.

When the car is being driven in first or third it will free-wheel, but the free-wheeling unit is inoperative when the second or fourth speed is engaged.

For a fast get-away the driver can start in low gear and shift immediately to second, and then declutch in the conventional manner and shift into the high-speed range, which will immediately put the transmission in fourth speed, since the vacuum control will remain in the higher-speed position.

A manual lock-out is provided to lock the transmission in second or high, depending on the position of the shift lever, so as to permit starting the engine by towing or pushing.

The reverse speed ratio is 3.25 and the position of the shift lever in reverse is the usual one. There is no shift-lever position corresponding to that for first speed with the conventional three-speed transmissions. It is estimated by DeSoto engineers that the shift lever will remain in the "high-range" position 95 per cent of the time.

ACHIEVEMENT of the customer's GOODWILL through SERVICE — that is the aim of the Accurate Spring Mfg. Co. in every dealing with users of springs. That this *goodwill* is being gained, that Accurate customers are *well served* can be seen in the rapidly growing list of Accurate customers — customers who are disposed to return again and again to Accurate for their Spring requirements.

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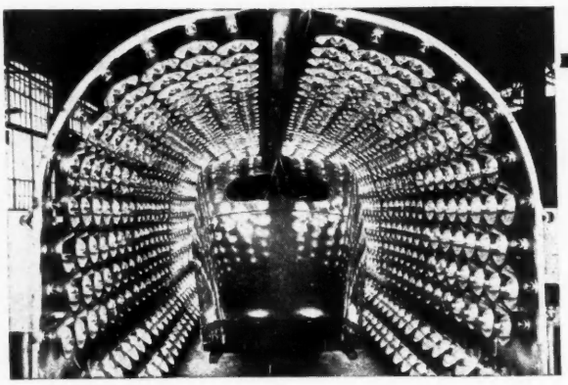
As compared with a car with the ordinary three-speed transmission, clutch operation and gear shifting are greatly reduced.

DeSotos this year will be equipped with the Safety rim which prevents throwing of a deflated tire. It appears that this rim, which was illustrated in our description of the Plymouth in AUTOMOTIVE INDUSTRIES of September 15, will be used on Chrysler products exclusively this year. The tire size has been increased to 6.25-16.

A rear stabilizer bar between the frame and axle has been added. The car also has a front sway bar which tends to keep the body level when rounding curves. Front and rear direction signals, operated from the driver's compartment, are available as extra equipment.

These cars are available in eight solid colors and four two-tone combinations. Solid colors are black, navy blue, regal maroon, garland green, Colorado spruce, Iris blue, Tropical tan and Pearl gray. Two-tone combinations are Colorado spruce upper and Garland green lower; Skyline gray upper and Iris blue lower; Pearl gray upper and Navy blue lower; Tropical tan upper and Regal maroon lower.



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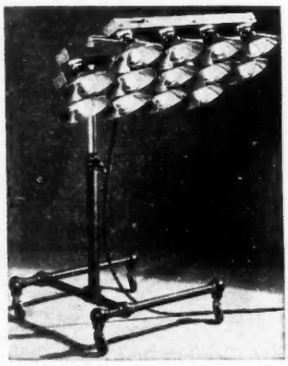

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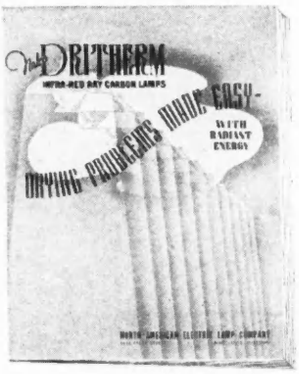

Be sure to specify Nalco Dritherm Carbon Filament Lamps for all infra-red ray drying installations.

NORTH AMERICAN ELECTRIC LAMP CO.

1022 Tyler Street St. Louis, Mo.

1941 Chevrolet

(*Continued from page* 309)

since the cylinder bracket is secured to the side of the transmission case instead of being made integral with the ball-joint collar. Clock-spring cushions in the friction clutch have been redesigned to give a deeper cushioning action. A circular groove is cut in the flywheel around the clutch driving surface, in which any grease from the clutch pilot bearing can collect.

Owing to added weight at the front of the car, the free height of the knee-action coil springs has been increased slightly and the capacity of the front-wheel inner bearings has been raised by changing the contour of the races. Wheel spindles were strengthened by increasing their diameter 3/32 in. The rate of the rear springs was lowered to an average of 115 lb. per in. A change in the angle of the rear-spring shackle reduces the effect of the number of passengers carried on the rear-spring rate.

Improvements in the steering gear include a change in the tie-rod seals and adoption of a heavier steering column.

Torque tube and propeller shaft are increased 5/16 in. in diameter and lengthened to take care of the increase in wheelbase. While the rear-axle ratio remains 4.11 an optional "economy" ratio of 3.73 is available.

In the new bodies the rear door is hinged on the center pillar, which latter has been enlarged and strengthened. The underbody or floor now is much wider, has a slightly deeper hump for clearance above the chassis drive system, and arches in a very gentle sweep from the base of the hump outward to a lower position, to place the entrance steps as low as possible consistent with appearance and adequate ground clearance. Longitudinal sills at the sides are made of heavier box section, and all reinforcing cross bars welded to the floor are strengthened. Those located under the floor, at the front and rear of the front seat, are strengthened to take the additional load due to the greater overhang over the chassis frame. A large box section is formed in the floor at the front of the wheelhouse and the rear kickup to act as a rigid cross member. Another box section acting as a cross member is added in the floor between the wheelhouses at the top of the kickup. A box-section cross member at the extreme rear of the floor gives the added stiffness called for by narrowing of the body to make room for the new gravel deflectors. Fore-and-aft channel sections are welded to the floor below the trunk location, to provide a rigid mounting for the fuel tank, which now is suspended from the body instead of from the chassis frame.

Front seats now are of all-steel welded construction. Steel tubing and deeply-ribbed stamped steel sections are used for the seat frame, and are said

to combine great strength with lightness. The cushion is made removable, to give access to the regulator and floor brackets, thus eliminating the removable cuff on the outside. This leaves the outside trim smooth and more finished in appearance. A more rigid attachment of the body to the chassis frame is obtained by the use of more two-bolt attachments and the addition of extra body bolts in new locations. Two-bolt attachments are now used at the dash and at each of the three body pillars on each side. Extra one-bolt mountings are provided on each side midway between the first two pillars.

The business coupe has the same body shell as the five-passenger coupe, with more luggage space due to the use of a larger body. The fuel tank, of 16-gallon capacity, is mounted inside under the package platform, the same as last year.

The eight-passenger station wagon is entirely new. Its body is mounted on the new larger chassis, and from the front bumper back to and including the cowl and windshield unit, the exterior corresponds to that of the special deluxe sport sedan. Rear fenders and stainless steel moldings at the lower edge of the body also are special deluxe parts.

The coupe pickup, like the corresponding 1940 model, is a business coupe with a pick-up box installed in the rear. The only change in the box for 1941 is that the deck opening and the tail gate are slightly narrower.

In styling, the sedan delivery follows the "sport-sedan" mode; it looks smarter, longer, lower and more massive than the 1940 sedan delivery. From the front bumper to back of the side doors, it is identical in appearance with the new sport sedan.

The loading space has been increased, the load floor having been lengthened from 70 13/16 in. to 72 in. and widened from 56½ to 60 in. The distance between wheelhouses was increased 1 in., which further adds to the loading space, and the height also is slightly greater than in 1940.

1941 Cadillac

(*Continued from page* 301)

common to all series. Centrally at the front there is a wide chrome radiator grille, and at each upper corner of this grille, approximately along the center line of the horizontal headlamps, there is a rectangular parking-signal lamp with a catadioptric (grooved) lens which spreads the light over a wide angle. Sealed-beam headlamps are recessed in the upper portion of the fenders and are outlined by a wide chrome bezel. Immediately below each headlamp is a circular chrome medallion cover. When fog lamps are ordered, these covers are removed and the lamps are recessed in the openings.

Bumpers are much heavier, with broad, curved ends for added fender protection. Massive bumper guards curve outward at the top to prevent bumpers of other cars from sliding over them. A streamlined grille guard at the front extends between the bumper guards. Rear lamps, which are mounted on the rear fenders, also have been fully streamlined and are curved to follow the fender contour. A long chrome fin at the top of the lamp bears an attractive ornament. This portion of the left rear lamp is hinged and when raised provides access to the concealed gasoline filler.

For the Series 61 there are new aerodynamic bodies of four types—a standard plain-back sedan, standard coupe, deluxe sedan, and deluxe coupe. The Series 63 comes in a single type—a trunk-back sedan with concealed running boards and rear-quarter windows. The stream-lined bodies introduced last year are continued on Series 62. Series 60S body remains basically the same, but has new exterior treatment and interior appointments.

The new Series 67 body has a low roof line. Division glasses are electrically-operated by means of control knobs in the arm rests of the rear compartment. Fenders carry horizontal chrome louvers. Rear fenders are fitted with wheel covers as standard equip-

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COLLOIDAL GRAPHITE USED FOR SPEED CONDITIONING OF LINK-BELT P. I. V. GEAR CHAINS AND LUBRICATION OF LINK-BELT CHAIN CONVEYOR SYSTEMS OPERATING AT HIGHER THAN NORMAL TEMPERATURES

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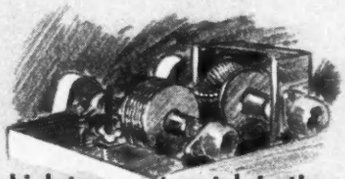
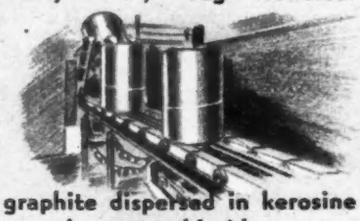


Being highly stable in light viscosity fluids, "dag" colloidal graphite dispersed in kerosine or carbon tetrachloride answers the carbon, smoking, flake-off problem. These fluids quickly evaporate under high heat with a minimum of smoke and carbon, leaving only pure graphite to furnish clean lubrication on the working parts of the conveyor.



A note on your company letterhead will bring Technical Bulletin Nos. 112 and 130 describing more fully why and how run-in and high temperature lubrication can be materially helped with "dag" Brand colloidal graphite.

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN

ment. Running boards, concealed when the doors are closed, are rubber-covered. All doors open from the rear and all door hinges are concealed, hence the exterior is quite smooth. Door windows are large, and a streamlined quarter window provides additional vision. The luxurious Series 75 body has been completely redesigned for 1941, to give it the modern streamlined appearance.

Sealed beam headlamps are continued and are mounted high in the fenders, which permits light to be thrown far down the road and also avoids possible damage from flying stones.

Directional signals are continued, with several improvements. The control lever now returns automatically to the central position with the steering wheel. A red light in the speedometer face flashes when the unit is in operation. Signal lights are located in the parking and rear lamps, turn signals being flashed by these two lamps on the side toward which it is desired to turn. Parking-signal lamps, mounted in each side of the radiator grille, can be used also in place of the headlights in semi-darkness. A series of angled prisms formed in concentric circles on the inside of the lens provide a concentrated area of light that is visible at a great distance.

Fan-cooled generators with voltage and current control are continued. The high-tension ignition wiring on the engine has been rearranged to reduce electrical interaction between wires. This reduction in the inductive effect between wires is said to increase the volume of the spark and to reduce the frequency of spark-plug cleaning and replacement.

Batteries of the same size as in 1940 are mounted in front of the dash outside the right frame side rail, where they are readily accessible and well cooled. They are equipped with a non-overflow filler plug.

The underseat heater arrangement with two heating units, one under each front seat, and a separate defroster and ventilating unit is continued for 1941, with a new thermostatic heat control and other improvements. The thermostat regulates the amount of water flowing through the units and also governs the speed of the fans. Defroster, fresh air and heater controls are mounted low on the instrument panel. Dash heaters are similar in operation and design to those used in 1940. Their output has been increased, and they are finished in new colors, to harmonize with the interiors. The motor is reversible, so that either direct or diffused heat may be obtained.

The No-Rol brake attachment, which holds the car on an incline, is available on order.

Only two commercial chassis are offered this season—Series 62 and Series 75, both with a 163-in. wheelbase. They differ in detail from the 1940 models to the same extent as do the standard chassis. Both models have the two-piece propeller shaft with three needle-bearing universal joints.

1941 Willys

(*Continued from page* 307)

38 m.p.g at 20 m.p.h., 34 m.p.g at 30 m.p.h., 25.5 m.p.g. at 50 m.p.h., and 20.9 m.p.g. at 60 m.p.h. Engine output has been boosted to 63 hp., with consequent improvement in acceleration in top speed.

A new, wider X frame permitted of an increase of 2 in. in the width of the rear tread. This frame has three times the torsional stiffness of the former one, although it weighs 5 lb. less. The car has a new hypoid rear axle, built by Willys, with a gear ratio of 4.44. The transmission, a Warner-Gear, is new; it has none but helical gears and is equipped with the latest blocker-type synchronizers. The column-mounted gear shift, which is now standard equipment, has been improved.

Adoption of the Ross twin-pin steering gear, in conjunction with an improvement in the steering geometry, is said to add to the stability and ease of handling of the car.

Use of the Atwood-Thelander friction clutch is continued. An 8-in. clutch is employed, which is equipped with

... SEES FARTHER

ATLAS ENGINEERS examine drawings for production economy; chemists and metallurgists, behind test tubes and microscopes, explore into the raw bar steel; others peer through pyrometers into glowing furnaces, watch heat registering meters, scan hardness testing dials, check surface measurements with finely calibrated instruments.

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the new Atwood-Thelander damper. This consists essentially of a hermetically-sealed cell at the center of the plate, containing a nest of helical springs fitted with hydraulic plungers which are controlled by sealed-in grease. The mechanism is said to function like a shock absorber, having a hysteresis curve in the form of a triangle, with negligible reaction at the low end and extreme reaction at the upper end.

While the engine remains basically unaltered—a four-cylinder L-head unit of 3⅛-in. bore by 4⅜-in. stroke (134 cu. in. displacement)—it has been improved in various ways. In the first place, its breathing capacity has been markedly increased by enlarging the port openings and the diameter of the inlet manifold. In addition, a full 1¼-in. (Carter) carburetor is now used. While this has slightly stepped up the maximum horse power, its importance is said to lie in the fact that it increases the torque at low speeds, contributing to better acceleration. With the cast-iron head and standard compression ratio of 6.48, the engine produces 63 h.p. at 3800 r.p.m; with the aluminum head with a compression ratio of 7.1 it produces 65 hp. at 3800 r.p.m.

Better engine insulation and improved mounting have done much to create a smooth engine. Bearings are of the new Cleveland Graphite Micro precision type, which has only 0.005 to 0.007 in. of babbitt directly on the steel back. Test engines with the new bearings are said to have been run wide open on the block for 100 hours at 4400 r.p.m. without failure. Valve springs are now made of manganese steel and are used without dampers.

Electrical equipment remains unchanged, as do the brakes, except for the fact that the hand-brake linkage has been simplified. The gasoline tank is now of seam-welded construction, with three-point support, and its capacity has been increased to 11½ gals., which makes it possible to cover 300 miles without refilling. The exhaust system has been improved by making the mountings more flexible. Front springs now have a slightly lower rate, and the Monroe direct-acting shock absorbers at the front are mounted more nearly vertical.

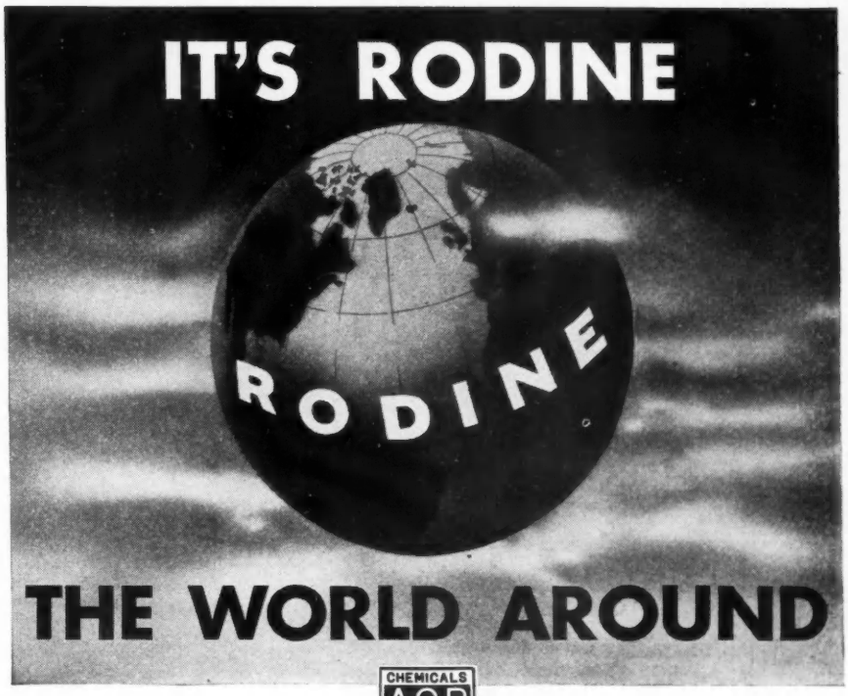
Bodies are new in every respect, the product of an extensive die program at Briggs. They are of the modern torpedo-type styling, with capacious luggage compartment in which the spare tire is carried in a vertical position. There is more leg room, 1½-in. added head room, and an increase of 2¾ in. in the width of the rear-seat cushion. A larger rear window of heat-treated, curved glass ensures better vision.

The zig-zag-spring type seat-backs and cushions, introduced last year at the front, are now used all around, and their use in the rear permitted raising the level of the rear seat. Adoption of the hypoid rear axle, with an offset of 1¼ in., made possible a further reduction of the depth of the rear-compartment tunnel.

From a production standpoint, the interesting feature of the body construction is the development of a large turret top panel which extends from the front down to the trunk lid. Bodies are prepared for assembly in major units, consisting of one-piece sides with doors fitted, front end and rear end, thus simplifying the assembly problem.

Other body features include an instrument panel with flush-type safety control buttons, a "remote-control" or inside hood latch, and door-control handles which while convenient for operation, are out of the way. Particularly noteworthy is the new Willys-patented door-lock striker, which is quite simple in design and provides an action similar to that of the familiar rotary lock.

Front-end treatment is entirely new with new sheet metal and interesting die-cast trim and ornamentation. The front grille is a long narrow one-piece die casting with closely-spaced vertical bars, set low in the skirt between the fenders. Die-cast moldings are run down the front of the hood and over the ornament along the top of the hood. A gravel shield at the rear end is standard equipment.



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DEPT. 312, AMBLER, PENNA.
Detroit, Mich., 6339 Palmer Ave., E. Canadian Branch, Walkerville, Ont.

Pace Set by Quality Control

(*Continued from page* 367)

The prime duty of the department supervisor is to make sure of the proper instruction and training of his inspectors. The company emphasizes this. He also acts, in cooperation with production foremen, as arbiter of any minor questions arising between inspectors and production employes. Harvester plants probably average one inspector to every 20 production employes, sometimes one to every 10 production employes, depending upon the nature of the work.

Inspectors are seldom drawn from the ranks of production workers. Most inspectors are hired as young employes and trained by the company specifically for inspection work. Many of them are graduates of technical high schools or other preliminary technical training.

The company keeps in constant touch with manufacturers of gages in order to keep abreast of current developments and frequently has cooperated with manufacturers in the design of new gages. One example of such work was in the development of Electrolimit gages for checking main bearing bores in crankcases.

The company also was one of the first to institute a competitive system of quality control by inter-departmental contests, a system which has been adopted by several other companies, with and without modifications. Briefly, this system involves the assignment of arbitrary credit ratings to each dimension of a part shown on the blueprint. These credits, expressed in points, are so arranged that departments can compete with one another equitably whether they are engaged on rough or precision work.

A special committee of quality inspectors makes unannonced visits to each department at irregular intervals, picks a certain number of parts at random from the day's production and checks them against the blueprints. For each error found, the number of points allocated to that dimension is deducted from the total points assigned to the part. The committee then computes the percentage relationship between total point deductions for errors and the total of possible points for all the parts inspected. That percentage is the quality rating of the department.

Packard

At Packard, quality control is organized under the direction of O. F. Sepanek, general chief inspector, delegated to nine divisional chief inspectors, all reporting to the department head.

It is the responsibility of the inspection head in the foundry and forge division to pass on to the machine shop, quality rough forgings and castings. For example, every cylinder block is checked on a husky steel fixture for all important dimensions. Water testing and hardness checks are made 100 per cent. Test bars are poured from every ladle of iron and a record is kept in relation to block numbers, even to the hour of the day's run, for reference. Cylinder heads, manifolds, transmission cases, connecting rods, steering forgings and other parts too numerous to mention are subjected to similar inspection procedures.

In the machine shop and motor plant the blue print rules. Inspection operations have been set up in the machine and assembly lines that vary from plug gaging steering knuckles and inspecting crankshaft finish, to measuring in tenths of a thousandth, with amplifiers, the size of pistons and cylinder bores. All new machine set-ups must have the approval of the layout room before machines are permitted to produce. Motors are carefully block-tested before being OK'ed for the assembly line.

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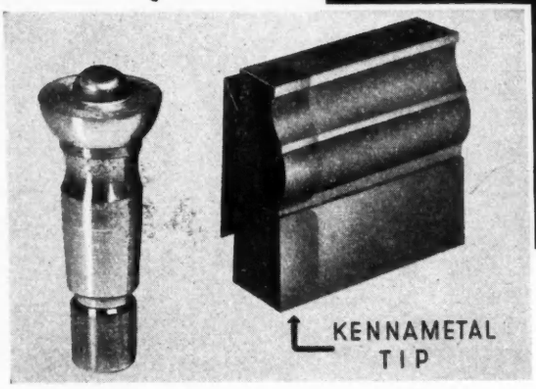

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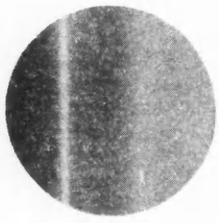
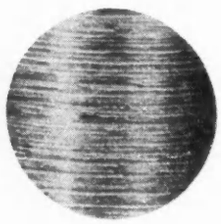
The KENNAMETAL-tipped Forming Tool in the above photograph will turn 500 steel tie-rod pins for automobiles at the rate of 300 per hour, and has a life of 30 regrinds or 15,000 pieces. Note the metal surface structures on the right.



Section of above tooled with KENNAMETAL Form Tool. Note smooth structure. (Enlarged three times — unretouched photograph.)



Unretouched photograph of section of similar piece tooled with ordinary tungsten carbide tool. Note torn structure.

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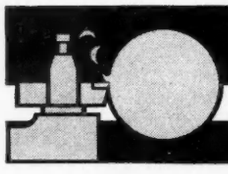

McKENNA METALS Co.
105 LLOYD AVENUE
LATROBE, PENNSYLVANIA, U.S.A.

missions is controlled from the gear laboratory. Here tooth form is checked, not only with every change of hobs and shaving cutters, but on gears being produced off every machine. Hardness and case depth also are continually checked. Differential cases and carriers and transmission cases are checked 100 per cent for alignment. Gears are matched in sets and assembled units are tested in insulated silent booths.

The checking of stampings starts with the first die tryouts which are completely laid out on a surface plate and continues throughout the program with every run. Fixtures gaging assembly conditions, contour and character lines have been developed for all important and major stampings. In this manner, a fender, bonnet top, body quarter panel, complete roof or a transmission synchronizer housing with a five-thousandth limit may be quickly checked and approval given to run or a stop order put on the press.

A division of inspection is responsible for metal and paint finish of fenders and all other chassis hardware as it is received at the assembly line, also for the quality of plated parts.

Purchased material comes in through two receiving inspection departments, one receiving body materials, the other chassis and motor parts. They perform two functions, one of sample checking of parts furnished by vendors when starting a new model and continued throughout the year; the other, a routine receiving inspection which involves everything from the shade of upholstery cloth and leather and noise testing of bearings to checking frames.

Final inspection is an inspection of the car as it is built, with inspectors stationed at various points along the chassis and final assembly lines, including a complete recheck of the finished car. Every car is tested for performance, the functioning and noise level of motors, transmissions, rear axles and instruments. Too, every car passes through the rain test and is checked for leaks, front wheel geometry, etc. Each car receives a mechanical OK before it is permitted to proceed to the final touch-up and final inspection lines.

Pontiac

The inspection department under Wm. H. Vann is composed of a group of 500 highly trained specialists, constitutes an independent organization outside the jurisdiction of the manufacturing division. Intensity of quality control depends entirely upon a study of the requirements of each individual part. Of the 10,000 parts that go into a Pontiac car, every part receives at least one inspection, some as many as ten inspections. Major parts and essential operations are subjected to 100 per cent inspection; others to a sampling check. In the rear axle plant where the requirements of control are unusually high, there is an inspector for every seven production workers; in the engine plant the ratio is one to nine.

The crankshaft is typical of the parts subjected to 100 per cent inspection. Each one is inspected for balance, index of pins, throw of pins, size, width and radius of each main bearing and connecting rod bearing. In addition, there are close limits where the flywheel fits on the flange, and index of holes for the flywheel. Fit of transmission drive shaft has to be very accurate for concentricity.

Another of the exacting jobs is that of fitting piston pins to connecting rods. This is a function of the inspection department. Limits call for an air gap between 0.0003 in. minimum and 0.0005 in. maximum.

Pontiac is one of the few manufacturers to track test every finished car. Every new Pontiac car is put through its paces on a quarter-mile concrete track. While this adds a little to the manufacturing cost, it permits a better determination of the performance of various assembly units. Squeaks can be detected more quickly this way; body interferences can be corrected.

In addition to the supervisors at the head of the inspection staff of each plant, are a number of general inspectors who interpret engineering specifications but do not handle personnel. Most versatile in their skill are the utility inspectors, who must be qualified

An OK that checks all the way!

MANUFACTURER, service man, owner—all the way through—there's one specification O. K. that checks with everyone. It's the Bendix Drive, *the mechanical hand that cranks your car.*

Every hour of every day the Bendix Drive proves its merit over and over again in millions of cars and trucks. Its operation is virtually fool-proof and trouble-proof. At the touch of the starter button, the Bendix Drive automatically takes hold, starts the engine, lets go—meanwhile protecting the starter from damage in case of inadvertent operation. Bendix Drive is built in sizes and types for every starting requirement.

ECLIPSE MACHINE DIVISION
BENDIX AVIATION CORPORATION
ELMIRA, NEW YORK

BENDIX DRIVE

"The Mechanical Hand that Cranks Your Car"

to fill in anywhere in case of the absence of a regular inspector.

Before production begins on a new model, the inspection department goes into every phase of the new product. Proposed machinery and processes are examined, new materials and specifications are checked to determine their manufacturing practicability.

It is interesting to find that the inspectors and their work are subject to regular inspections and examination. To this end, a finished car is taken out of its regular routine, periodically, and every detail checked for quality and reviewed with respect to the work of the inspector who passed on any part of it. This investigation is made possible through the use of an inspection card for each car, on which is kept a complete record from the time the chassis is placed on the assembly line. This system applies only in the assembly plant.

Pratt & Whitney Aircraft

The quality control department, under the jurisdiction of E. S. Marks, quality engineer, consists of three main groups—the chief inspector, responsible for material and dimensional control; the process engineer, responsible for the control of technical processes such as plating practice, heat treatment, painting, cutting fluids, etc.; and a third group, responsible for inspection instructions for each part.

The quality engineer is accountable only to the head of the engineering department and, in consequence, is independent of the production department. It is of interest to learn that the ratio of inspectors to productive workers is of the order of 1 to 10.

Machine operators are provided with work gages for checking their own operations, such gages being made to closer limits than the inspection gages so as to make proper allowance for the tolerance on the inspection gages. Individual inspectors are permitted no leeway in the acceptance of parts that do not fully meet drawing specifications, and all such work is automatically rejected. It is not, of course, scrapped, but is subjected to the scrutiny of a committee representing the engineering, service, manufacturing, and inspection departments. This committee decides whether the material is to be salvaged or scrapped.

A major function of the inspection department is to supervise the final engine tests. Each engine, after its original assembly, is subjected to approximately 10 hours of operation, during which it is operated with a gradually increasing load until, during the last two hours, it is run at, or close to, its rated power output and speed. During these two hours, performance in terms of power, fuel consumption, air consumption, and oil consumption, is checked, and the engine is inspected for external oil leaks and functioning. After this initial operation the engines are completely disassembled, all of the parts laid out on tables, and subjected to the most severe scrutiny by P & W inspectors, as well as those representing its customers.

Accessories receive a careful inspection during the "green" test, and important units go through an additional inspection procedure after the first shakedown test. Carburetors, for example, are given a complete check in a specially constructed test chamber where the metering characteristics are verified in accordance with specifications.

Following these inspection practices the engine is fully re-assembled and subjected to two or three hours final testing, wholly within the inspection department's jurisdiction, and a careful check is made on its performance characteristics and conformance with all specification requirements. Each engine thus receives about 15 hours of operation before delivery. An interesting sidelight on the strict control is that should it be necessary for an engine to receive excessive running in order to meet its performance guarantees, the inspection department can reject the engine as a whole.

For obvious reasons, the control of materials going into the manufacture of various parts constitutes a basic inspection function. However, due to the

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scientific nature of the facilities required for this purpose, the control of materials is vested in the research department rather than the quality control department. Under the supervision of the research engineer, the company maintains extensive analytical and physical testing laboratories supplemented with facilities for examination with X-ray, spectroscope, microscope, and diffraction apparatus.

Raw material inspection is two-fold in scope, embracing not only the materials used in the plant but by its manufacturing sub-contractors as well. While most raw materials are received and accepted on the basis of a certified analysis from the vendor, it is the practice to double-check the chemical and physical properties to assure conformity to specifications. Magnetic inspection of steel, both by eddy current methods and with Magnaflux equipment, is carried out under laboratory supervision.

Studebaker Corporation

Quality control is under the direction of C. E. Floody, chief inspector, with a foreman in charge of operations in each of four principal divisions of the plant —machine shop, stamping and spring manufacture, receiving department, and the chassis and final car lines. The latter also includes inspection of sheet metal in the paint shop, body inspection, and road testing.

In addition to these major functions, the inspection department operates a salvage division and a gage division, the latter being responsible for all measuring devices used in production.

Generally speaking, the Studebaker set-up operates on the basis of line inspection with inspectors in every department. On major parts such as the cylinder block, for example, there is a close inspection at every stage of the machine line so as to assure perfection of detail at the end of the line.

An interesting feature of quality control is the program of checking every major engineering change to assure conformity with related assemblies and manufacturing set-up. This eliminates interferences, brings out new manufacturing problems before the change is released for production. In some cases, the procedure involves road testing which parallels the work of the experimental engineering department.

Following a growing trend in the industry, Studebaker recently inaugurated a surface quality program which is handled by a special quality man. To rationalize this work they have purchased a Profilometer which has become the final arbiter of surface quality measurement. At the present time, the instrument is used for checking certain vital parts such as the crankshafts, cylinder bores, cam shafts, and piston pins. A sampling check of parts in the machine shops is made daily by the quality man who keeps a daily record of the trend. Some impression of the standards now established may be gaged from the fact that crank pins and journals are being held in production to a finish of four to six micro-inches (r.m.s.).

Pistons and wrist pins are inspected in an air-conditioned booth in which the room temperature is held to 72 deg. F. Unique feature of this set-up is the use of special gages for checking the cam contour of the pistons. The gage is provided with a series of points spaced around the periphery, the contour being precisely gaged at each of these points.

Another unusual detail is the adoption of air gaging for a number of important bores. This method is employed for checking the bore of the conrod big end. Latest application of air gaging is found in the inspection of the crank bores in cylinder blocks, checking not only the diameter of the bores but their axial alignment as well.

Studebaker is justly proud of the wheel alignment machine which was built here. The machine has easily sliding ways which automatically accommodate a variety of tread widths. In operation, the front wheels are rapidly rotated by rollers to simulate the situation on the road, then the tie-rod adjustment is made by two operators, one for each wheel, while the test driver holds the steering wheel in the neutral position. The operators work in a pit, each one having a sensitive gage for

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setting the wheel for the desired toe-in value. The entire operation is performed in a matter of a few seconds.

Another important activity of the inspection department is the road testing of production cars as they come off the final lines. President models are road-tested 100 per cent; and a certain percentage of all models are taken out on the road as a sampling check. Prior to road testing, the final tuning of engines on finished cars is handled by members of the inspection department.

AC Spark Plug

Quality control in this plant is under the direction of Sydney N. Lyttle, who heads a group of over 350 inspectors under the immediate supervision of inspection foremen in various departments. In addition to their other duties, the inspection foremen maintain close cooperation with the manufacturing department, carrying this relationship right to the machine operators. In this manner it is possible to watch piece-parts right at the machine and to eliminate defects that might pass by the inspectors.

The functions of the inspection department at AC cover every conceivable phase of activity as may be noted from the following outline:

Receiving Inspection—The function of receiving inspection is to check dimensionally, chemically, physically, and visually all raw materials and purchased parts that go into the manufacture of a product. This department operates usually with standard measuring devices, such as micrometers, torsion machines, elongation machines, hardness testers, etc. Some equipment may be fitted to special requirements of a product.

Process Inspection—For material in process, usually fixed gages to limits are used. These gages are generally labeled with part numbers to agree with the parts they are set up to check. Often multiple gages are made up to check more than one dimension.

Tool and Gage Inspection—This is a highly specialized department, charged with the maintenance of gages and the design of new gages. This department also keeps the records of gage disposition. They are the absolute authority of measurement.

Batch Inspection—Often in mass production, it is impractical to gage or visually inspect each piece, either because the part would not warrant it or because it may be a part produced by automatic machinery. In these cases a percentage of the parts are inspected at given intervals or by batches and by the laws of probability it is assumed that the larger number agrees with the samples. This is a useful method of control for such parts as screws, bolts, stampings, etc.

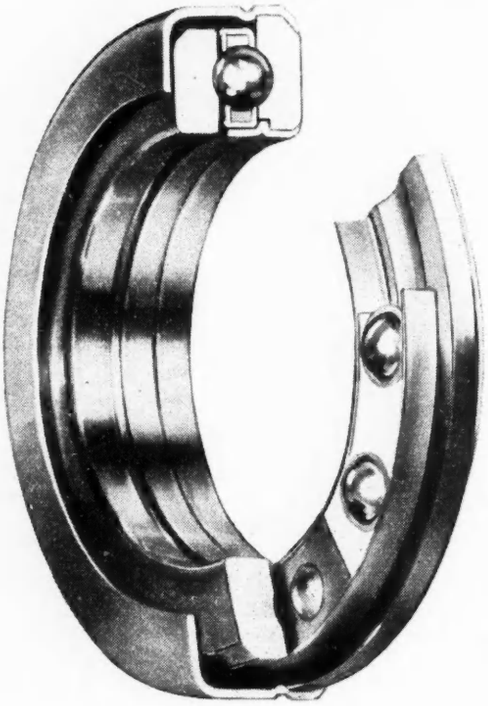
Final Inspection—A final inspection is usually a duplication as nearly as possible of the function of the part or assembly. In this phase of inspection, finish and color usually play an important part. Final inspection also usually includes boxing or packing and labeling.

Inspection Service to Customer—The function of quality control or inspection is the correct interpretation of the customer's wants. In order to do this most effectively, a small staff of men contact the customer to study his conditions and to make sure that his wants are being met to the best advantage.

Coming to some of the details of inspection process, we find that critical attention is given to the checking of aviation and automotive engine bearings. The split line height of all bearings is measured by means of precision-made nests and masters which permit readings to the ten-thousandth of an inch. Bearings are inspected 100 per cent immediately after broaching and regular routine checks are made to assure the maintenance of the desired quality. Control of wall thickness also is important and a tolerance of 0.00025 in. is maintained on this dimension.

In the manufacture of fuel pumps, quality control begins with the analysis of raw materials. The process of manufacture is broken down into individual operations, which are constantly checked by trained operators and rechecked by inspectors. When a number of parts have been completed, they again receive a percentage check before going

WHY ARE SO MANY OF THE NEW CARS EQUIPPED WITH THE BCA PRELUBRICATED CLUTCH BEARING ?



A QUIET, smoothly operating clutch is one of the "musts" in present-day motor cars. A clutch bearing which will continue to function properly for the life of the car is a "must".

Without exaggeration, we can safely state that the BCA Prelubricated Clutch Bearing is the surest, longest lived, smoothest operating Bearing for the clutch position. This has been proved by the experience of many leading car manufacturers in recent years.

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BCA RADIAL • ANGULAR CONTACT • THRUST BALL BEARINGS

to the assembly lines. These checks and rechecks are made on specially designed gages for dimensions and functions of the individual parts.

On the assembly lines the operators are trained for each individual operation. Also, special tools and fixtures are used on the various operations. All operators, as well as tools and fixtures, are checked periodically by inspectors and foremen to insure proper assembly methods.

When the pumps are completely assembled, they receive a 100 per cent functional test and visual inspection before being placed in containers for shipment to the customer. This functional test consists of running the pumps under conditions very similar to the actual operating conditions of a car.

1941 Nash

(*Continued from page* 403)

sealed type are standard equipment on all Nash cars. An optional extra is a fourth-speed forward, which is claimed to cut fuel and oil bills by from 20 to 30 per cent.

Other features found in Nash 1941 models include tail lights that also illuminate the trunk compartment, clutch-pedal starters, a hood lock operated from the instrument panel, a safety foot control for the radio, High-test safety glass all around, voltage-control generators, foam-sponge seat cushions, ventilating rear-quarter windows, and sliding bolt locks on front ventilator wings.

New Research Building

(*Continued from page* 316)

might occur if the oil were checked by weighing before and after drain periods.

Blow-by, a part of the piston and ring study, is accurately recorded by a meter hooked up to the crankcase. All ventilation to the engine is shut off. Any pressure developed in the crankcase resulting from blow-by is run through a moisture-removing felt-baffled tank and then through the meter. These blow-by tests are the only ones which cannot be observed from outside the test rooms.

Cold starting tests are accommodated in an insulated cold room which has refrigerating coils across the entire ceiling area and a heavy refrigerator door. While an observation window has been installed, a telephone is also provided so that observers inside the cold room can report their findings to the recorder outside. Tests are made at —10 deg. Fahr. to insure positive starting at zero in actual service.

Chemical and metallurgical laboratories completely equipped with modern testing equipment have been provided for close and continuous control over all of the materials used in engine production and to check experimental work.

A completely equipped darkroom has been installed in conjunction with the metallurgical laboratory, where a Baldwin-Southwark machine for testing tension or compression up to 200,000 lb.; a 100-in.-lb. Tinius Olsen impact testing machine for small cast iron and steel samples; Monotron, Rockwell and Brinell hardness testing machines and a Hevi-Duty electric furnace for treatment of laboratory samples have been provided. A Bausch & Lomb research microscope with camera for checking and recording microstructures, grain size, cleanliness of metals and other details, has also been provided.

Overhead bus-ways have been installed to facilitate power distribution throughout the machine shop and metallurgical laboratory where combination high-intensity mercury-vapor Mazda lamps have been installed. Thermostatically-controlled unit heaters are provided to meet the requirements in each department and the test rooms and are served by an oil-fired burner.

Offices have been provided for the engineering staff and Don J. Cummins, who supervises the research and development work. Details of the entire structure were worked out by Austin engineers in close collaboration with the two Cumminses and A. F. Loertz, plant engineer.

THE AMERICAN WAY

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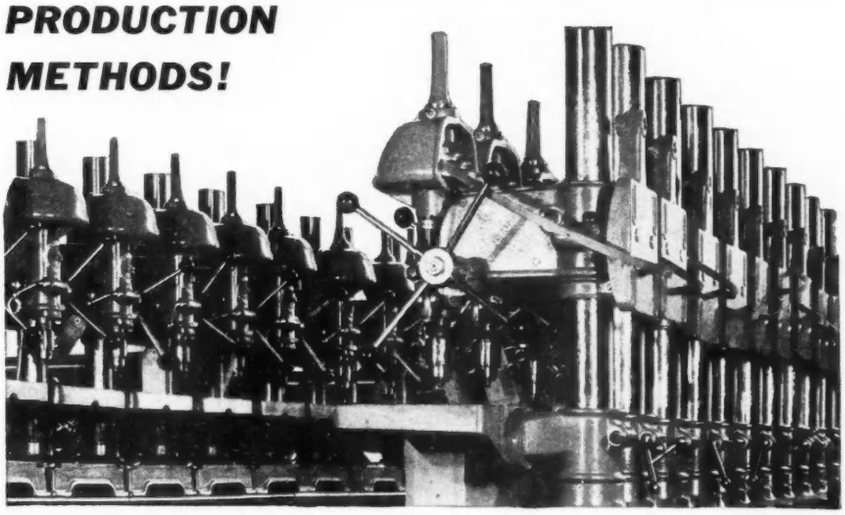

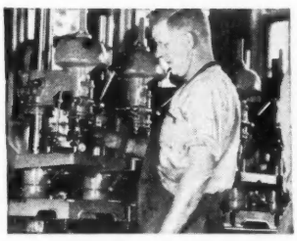

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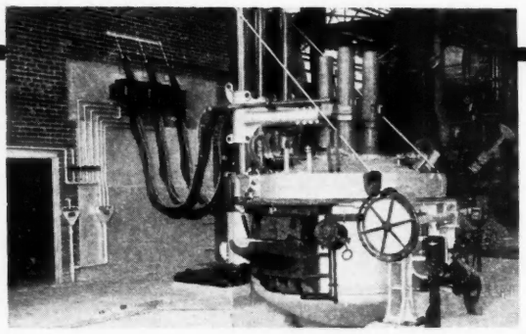

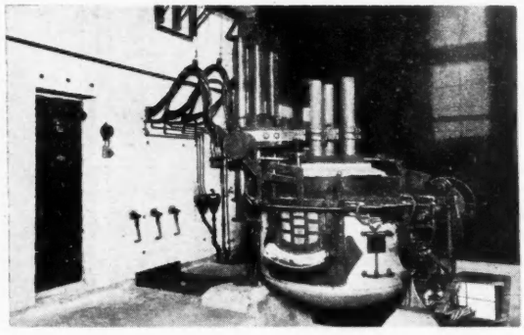

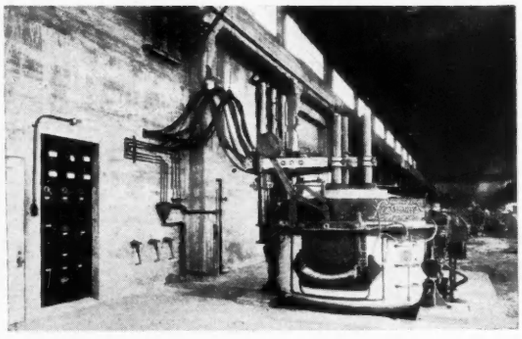

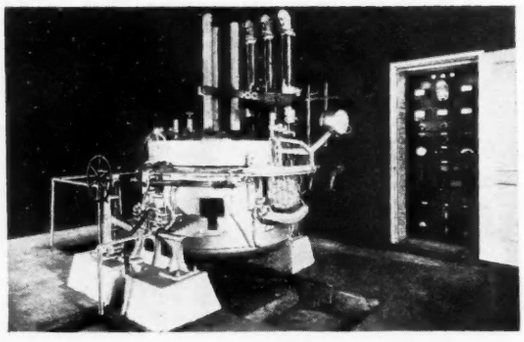

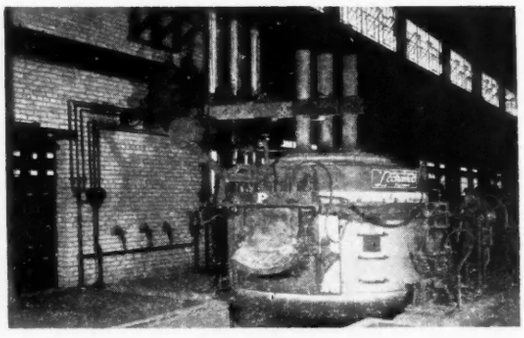

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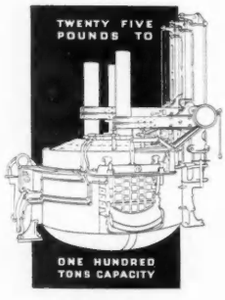

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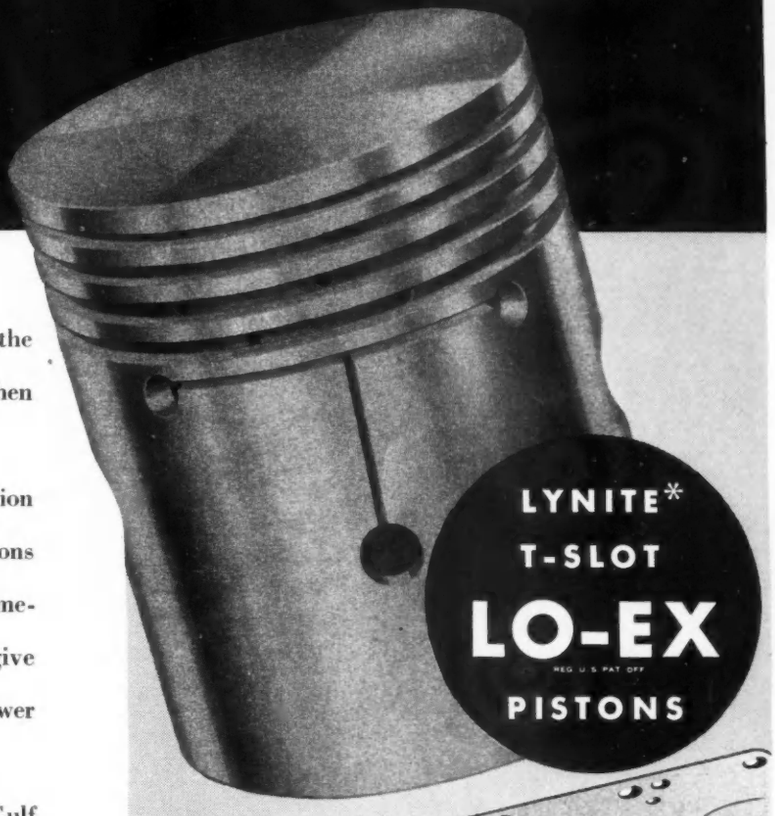

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For real engine "oomph," here's a combination that can't be beat; Lynite T-Slot LO-EX Pistons and Aluminum Cylinder Heads. They're something to lift the hood and talk about. They give greater acceleration, higher torque, more power and lower operating costs.

ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh, Pennsylvania.

PRODUCTS OF
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Defense Program in Action

(*Continued from page* 283)

ject to change, mainly in the light of the battle experience in Europe, which showed several important developments not anticipated in existing designs. The airplane and engine programs were the first to be tackled, being the important items on shortage. Engine production was somewhat ahead of plane production due to Allied orders having been placed in quite generous quantities. Planes for Britain were also on order but generally represented types different from American designs with constant attempts to incorporate improvements mainly in performance and gunnery. A survey was therefore made of engine and plane capacity versus requirements and a definite allotment of planes and engines for the Army, the Navy and the British. The numbers of planes were agreed on and the distribution, with the understanding that each plane was to have engines, and any surplus of engines was to be allotted according to the needs. It was estimated that 33,000 planes of all kinds could be manufactured between July 1, 1940, and April 1, 1942. The planes were allotted to the factories by types. The engine question was handled by taking into the picture Continental, Ford and Packard with Pratt & Whitney, Wright Aeronautical and Allison, which gave us six manufacturers of standing for combat engines.

Contracting was started on the planes, but unfortunately Congress reduced the profit rate in the Vinson-Trammel Act, which applies to combat Navy ships and airplanes only, from 12 to 8 per cent, which in itself, perhaps, was not too bad, but as it applied to sub-contractors who had orders for $25,000 or more of goods, this confused the picture terribly and caused delay in the signing of contracts. We held a meeting with the plane builders, who agreed temporarily to keep work going by tentatively agreeing on a cost plus a fixed fee contract and which we did not consider desirable, except on large planes weighing 15 tons or more. However, with the help of the White House an announcement was made whereby an accelerated depreciation rate was given approval with the consent of the chairman of the Ways and Means Committee in the House and the chairman of Senate Finance Committee in the Senate, and it was announced that this feature, plus the suspension of the Vinson-Trammel Act would be made part of the Excess Profits Tax Bill now in Congress.

In addition, our commission has worked out a plant facilities contract which guarantees the manufacturer the total cost of additions to his plant, or the cost of a new plant over a five-year period. This is a separate contract aside from the parts contract and provides the Government equity to be protected at the end of the emergency or in case of cancellation before the five-year period is over. The idea of this form of contract is to enable industry, through their regular banking channels, to handle part of the defense problem. Naturally, plants having no commercial value after completion of the program have to be financed by the Government, and title to such properties must rest with the Government even if the plant is operated by private industry under a management fee contract. I refer here to powder and ammunition plants, loading plants, heavy shell forging and armor plants, of which there is little private capacity and of which there is certain to be surplus capacity after the emergency is over. The Government will have the absolute control of such plants after the emergency and can elect to retain them for future emergencies. When it comes to plants having equipment now, which can be used or expanded, the policy is to let private funds or even RFC funds furnish the capital, and after the orders are filled negotiations will then be instituted with the manufacturers establishing the fair value of the facilities and subject to the approval of the Secretary of the Army or the Navy, as the case may be, the project will be closed by being taken over by the manufacturer.

Men at Work

in the private offices and in all corners of automotive industrial manufacturing plants, influence the buying of materials, tools, machinery and equipment.

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